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SOILS, CHEMICALS, IRRIGATION, ENGINEERING AND ECONOMICS

VOLUME 8, No. 7 JULY 1956
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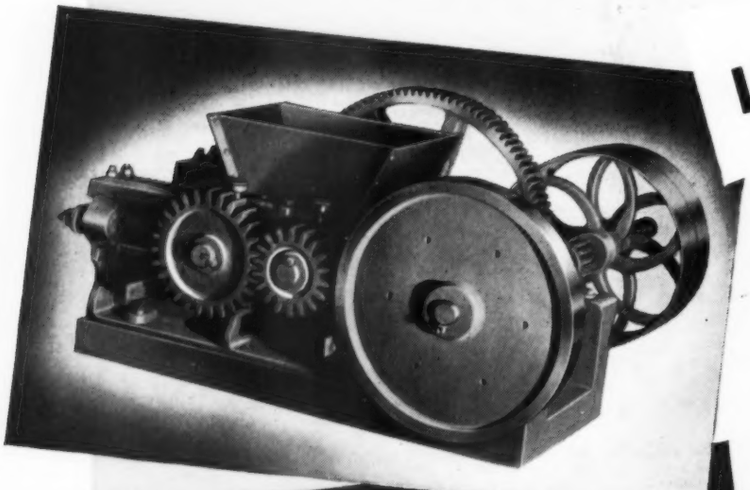

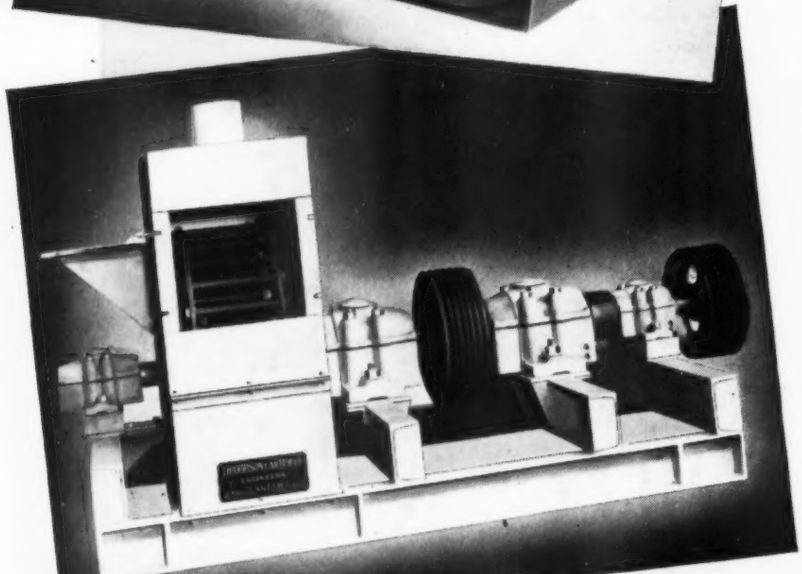

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WORLD CROPS

Vol. 8, No. 7 JULY 1956

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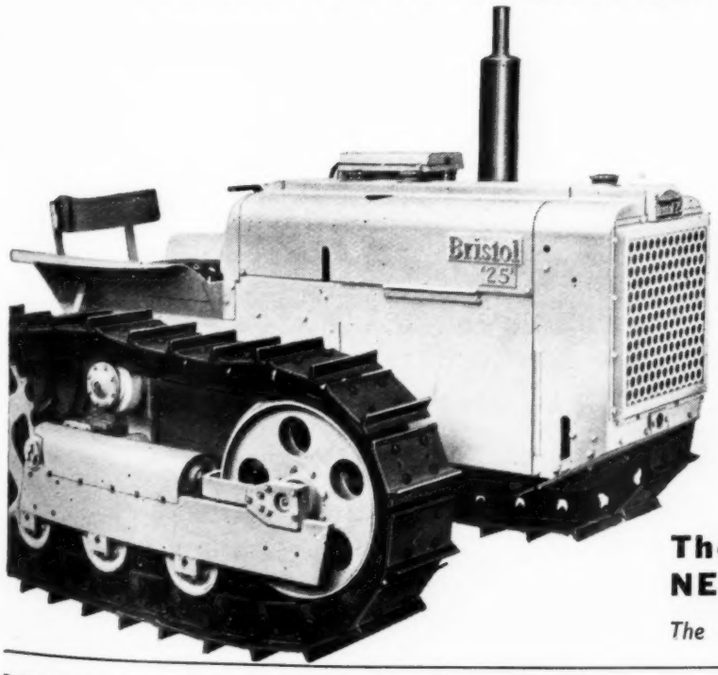

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But the tea bushes of Ceylon have constantly to be protected against diseases — among them Blister Blight. Here the problem was not to find a fungicide — a copper compound was known to be effective — but to develop a technique of spraying the bushes so that the fungicide could penetrate and do its job. Plant Protection Ltd was called in and, in collaboration with the Tea Research Institute, they evolved a technique of low-volume spraying which proved completely satisfactory.

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Editorial Comment

Our cup of tea

SEVERAL authorities in the tea-growing industry have contributed to this issue of WORLD CROPS in order to present a broad survey of the industry from an economical and technical viewpoint. Among the contributors are Mr. C. R. Harler, who discusses the cost of opening-up tea estates, with special reference to India, Ceylon and Africa; Mr. D. H. Laycock, who reviews comprehensively many of the difficulties that have been overcome in the Nyasaland tea industry; and, finally, two authors, both researchers at Tocklai Experimental Station, Assam, contribute authoritative articles, one dealing with ground cover crops in young tea and the other giving an account of tea-selection and -breeding methods in India.

U.S. farm surplus

THE much publicised problem of America's farm surplus is once again in the news; this time with a more frightening twist. A report issued by the National Planning Association states that if present production trends continue the nation's farm surplus will double in the next 10 years.

Last year America's surplus farm production was 4%. In the National Planning Association's report, however, Prof. John D. Black, of Harvard University, and Prof. James T. Bonnen, of Michigan State College, estimate that under the present programmes there would be an 8.8% surplus of farm products in 1965. This surplus would be even greater without production controls.

The economists say that high price supports should be halted and prices should be allowed to fall well toward their free-market level if the situation is to be remedied. The difference between these prices and a 'near-normal' farm income should be made up by 'direct payments' to farmers.

Holding price supports at high levels works in exactly the opposite direction from that needed. Such high fixed price supports are a strong positive subsidy to an over-expansion of production which is already over-expanded, says the report.

The report goes on to say that in a free market prices could be kept from falling too low by having the Government enter the market as a buyer. Prof. Black and Prof. Bonnen estimate that production should rise no more than 12.5% by 1965 if it were to balance an anticipated increase in consumption of 16.9%.

The authors based their estimations on the assumption that there would be a population of 190 millions in 1965, no hot wars, continued high-level economic activity, an increased labour force, increased output per worker and a two-hour decrease in the working week, and normal weather conditions.

The National Planning Association's report was approved by its agriculture committee, which includes officials of leading farm organisations, farm economists and writers.

Dairy farm costs in Dorset

THE regional economic surveys conducted by British universities' farm economics departments are as valuable in this century as the plot and field tests of research centres were in the last century. Unfortunately, the limited resources for this type of investigation mean that the size of the sample—the number of farms costed—is sometimes too small to be regarded as entirely representative. One of the latest reports of this kind comes from the University of Bristol and is an economic study of 46 small dairy farms in North Dorset for the period 1953–54. On one point alone, the economic contribution of fertilisers, the results deserve wide circulation. It is so frequently urged today that dairy farms should make a full use of fertilisers to produce more grass for grazing and silage and bigger home-grown feeding crops, thus reducing their costs for purchased animal foods. Does this study of small dairy farms in the West support or disprove this general argument?

Of the 46 farms in the survey, nine bought neither fertilisers nor lime and relied only upon farmyard manure; 15 farms used lime generously during the year; 26 farms used nitrogenous fertilisers; 10 made some use of compound fertilisers. Basic slag was used on seven farms, and when used was applied generously. The use of other phosphatic fertilisers or potash in 'straight' forms was small. (Admittedly, these numbers of farms add up to more than 46, but in several cases the same farm used more than one type of fertiliser in the year.) Here, then, was a widely varied pattern of fertiliser use.

If financial results are considered, it is found that the best results go with the highest investments in fertilisers. The 12 farms with the highest income per acre spent an average of £56 per annum on manures; the 12 farms with the lowest income per acre spent only £17. It would be sweepingly incorrect to attribute the income difference to this factor alone, but higher fertiliser use is clearly a contributory factor in profitable milk production. However, farm income is not actually profit. When the farms were grouped to show the 12 with the highest margin between income and costs and the 12 with the lowest, the former group revealed an expenditure of 24s. per acre on manures, the latter

group an expenditure of only 8s. Expenditure upon feeding-stuffs *pro rata* was almost the same for both groups. Yet throughout this survey as a whole expenditure upon fertilisers must be regarded as rather low, and production from the grassland could have been more intensive; for all that, differences in rate of use are clearly associated with higher output and higher profits.

Dr. Cardon's resignation

DR. P. V. CARDON'S resignation as Director-General of FAO came as a surprise and a shock both to member governments and to the staff of the secretariat. The Independent Chairman of the Council of FAO called it to open its 24th session in Rome on 18 June to consider action arising from Dr. Cardon's resignation.

Dr. Cardon submitted his resignation to the Council Chairman, Mr. S. A. Hasnie, on 5 March. In his letter of resignation he said that, after consultations with his physician, ' it is my conscientious judgment that, in my state of health, the welfare of the Organisation, myself and my family will be best served by my retirement '. The letter also asked Mr. Hasnie that provision be made for the earliest possible election of a successor, and that an appropriate interim arrangement be authorised to lighten the burden of his duties.

Since his announcement, Dr. Cardon has been unable to continue his work. Under the FAO rules of procedure, Sir Herbert Broadley, the Deputy Director-General, has been empowered to act in his place.

The Council meeting will deal only with the item ' Action Arising Out of the Notice of Resignation of the Director-General '. Should it decide to call a special session of the conference, it would be possible to fulfil the mandatory rule requiring 30 days' notice and hold the session in association with the 25th Council session in September. The June Council date thus makes it possible for the Council, if it so decides, to call a special session of the conference at an earlier date than would otherwise be possible. The next regular Council session has already been fixed for 10 September. This session could not, because of the 30-day rule, call a special session of the conference before mid-October.

Farm price review

THE British Government's recent farm price review decisions appear to have caused considerable dissatisfaction among farmers. At the end of April the Council of the National Farmers' Union of England and Wales instructed its President, Sir James Turner, to seek an immediate interview with the Minister of Agriculture to express ' the dissatisfaction felt by farmers throughout the country ' as a result of the price review decisions. The President was also instructed to discuss with the Minister means of devising practicable methods of providing the industry with longer-term assurances of support, the desirability of which was acknowledged in the White Paper on the review.

After the price review in February the Government prescribed an increase of £25¼ million in the level of agricultural price guarantees, against increased costs during the previous year of £45 million.

The National Farmers' Union contended that the total award should have been higher in view of the decline in farm incomes and that its allocation among the various commodities failed to make an adequate allowance for the rapidly rising costs of producing milk, pigs and eggs, the basic products of many small farms.

At its meeting in April the Council considered resolutions from county branches endorsing the action of the Union's price review team in refusing to agree with the Government's decisions.

Describing the number of resolutions as 'impressive', a spokesman of the Union said they were evidence of the widespread and growing feeling of dissatisfaction among farmers since the price review results were made known. The Council had also received a resolution from the Welsh Committee of the Union expressing ' a complete lack of confidence ' in the Government's agricultural policy.

The Union is to invite the collaboration of the N.F.U. of Scotland and the Ulster F.U. in a joint examination of ' the problems facing the industry and an assessment of its requirements if essential stability of policy and price structure are to be achieved '.

Plastic bags for silage

EXPERIMENTS at Rutgers University College Farm, New Jersey, U.S.A., during the past four years have shown there is no wastage when grass is ensiled in plastic bags. So far the method has only been used for packages up to 75 tons and it may be impracticable for larger parcels. But small quantities could be stored at strategically placed sites on the farm. The great advantage in using plastic is that it ensures an airtight seal, allowing anaerobic conditions to develop quickly so mould growth cannot occur. Losses in dry matter content of the silage are avoided and its protein and carotene content remain high because leaching and seepage cannot take place.

In filling, the bag is rolled down like a stocking until it is only about 3 ft. deep. The chopped silage is then blown in, consolidated by tramping, and the bag is unrolled another 3 ft. The mouth of the bag is finally tied firmly with strong cord. Two holes are then made in the bottom to allow excess moisture to leak away. As soon as this has ceased to flow the holes are resealed

with insulation tape. Gas produced by the fermenting silage is insufficient to burst the bag.

Polythene and polyvinylchloride have been the plastic materials used and these have proved strong and durable. No deterioration has been caused by weather or contact with the silage. The bags are easily torn by sharp instruments, but holes and tears may be repaired with insulation tape. Animals may also cause damage, and it is necessary to put a secure fence around these silos.

Costs under U.S. conditions are well within practical limits. This year co-operative trials with farmers will be undertaken in the U.S.A. to test further the durability of the plastic under ordinary farm conditions. It is hoped to discover how the silos stand up to rodent attack and the cost angle will be scrutinised closely.

Can 'small' farming stay?

NOTHING in British agriculture has been more controversial than the 1956 prices review and its aftermath (see 'Farm price review'). For the first time the settlement was not reached by official and farming agreement. The farmers' unions disagreed—and the Government was left to announce the settlement alone, and as (virtually) an imposed settlement. Yet there were many keen agriculturists, people whose enthusiasm for farming progress and security cannot possibly be queried, who regarded the 1956 settlement as a good one, or at least as one that was very much better than might have been expected. It increased support for farming by some £25¼ million per annum; and the policy of production grants, or subsidy help for technical expansions, was strengthened. When the reasons for disagreement are sought, they emerge openly enough. The settlement could not ease the small farmers' economic difficulties. Price support had been increased very little, or not at all, for the main products of most of Britain's small farms; and the bolder increases in support or production subsidies were far more likely to benefit the large-acreage farmers. This was the crux of disagreement and every farming paper's correspondence columns revealed it.

Now, if we turn to America, where farm subsidy problems are no less discordant and complex, we find this being said in the editorial of the American Chemical Society's *Journal of Agricultural and Food Chemistry:* 'One of the vexing aspects of the problem is the small farm, which more accurately should be described as the small, relatively inefficient, low-income farm. We have suggested before that such farms are on the way out. And we have been criticised as favouring bigness for its own sake. . . . Many such farmers are leaving the farm and finding other means of livelihood. But there are some who appear determined to make a go of it or prefer farming as a way of life. It is an important principle that a man should have the privilege of trying to make a living by any honourable means of his choice. But the Government does not have the responsibility to see that he is flourishing and prosperous regardless of the effectiveness of his pursuit'. In our view, this is courageously and realistically said. However unpalatable, it must be recognised as hard sense, for in no modern state is the community as a whole likely to go on paying out general subsidies to a single industry whose production costs vary so widely from unit to unit.

To quote again from the same U.S. source: 'The small farm . . . is finding it almost impossible to stay in the race. Among other barriers is the need for large capital investment to make use of new technology'. In Britain, where the small farm is so often the product of tradition and local geography, this generalisation may not be quite so true or there may, at any rate, be more exceptions. But need the small farm have high costs? Need it be so technically non-progressive? If OEEC publications on such matters as fertiliser use, liquid-manure conservation etc. are studied, it will be found that one reason why these things are so effectively done in Holland and Denmark is that most farms there are small, intensively managed farms. The very countries in Western Continental Europe whose outputs per acre are highest in the world and whose production costs are so competitive follow a pattern of small-acreage farming. So it would seem that the answer is to be found across the North Sea, where, without much help from subsidies, small farms and their farmers flourish.

SPC recommendations

THE need for research into tropical livestock and pasture improvement was stressed at the session of the Economic Development Standing Committee of the Third South Pacific Conference at Nasinu, Fiji, on 25 April. The Committee was dealing with a statement of the work done on resolutions of the second conference held three years ago.

One resolution noted that the S.P.C.'s work programme included attention to tropical livestock introduction and improvement and recommended that steps be taken to meet the needs of territories where livestock could become an important element in the subsistence of the islanders.

M. E. J. E. Lefort, Executive Officer for Economic Development, said such an undertaking could founder unless the necessary fundamental research was made, not only about the best breeds of cattle for the tropics, but also the best types of grasses. That was the main reason for the proposal to set up a pasture and livestock improvement station in New Guinea.

Some differences of opinion about co-operative societies were expressed by delegates from Netherlands New Guinea and the Cook Islands. The Netherlands

New Guinea opinion was that the greatest care should be taken before co-operatives were formed. The Cook Islands opinion was that the co-operatives were voluntary and that the islanders were educated about their purpose and operation. They were not forced to join.

The New Guinea delegation (Australian) said there were now 198 societies in the territory. They had 54,250 members, with a capital of £A285,300, and a turnover last year of £A966,603.

The Committee resolved to recommend to the conference that the Rockefeller Foundation be thanked for its grant to the Commission to help in the campaign to eradicate the rhinoceros beetle, that a coconut research station be established in the South Pacific, and that a survey be made of the possibility of expanding the production of sugar throughout the region.

U.S. farm bill veto

ALTHOUGH the President of the U.S.A. has vetoed the farm Bill that Congress sent to him, he has tried to meet it halfway. It is clear that he recognised that the basic complaint of the Congressional opposition to his original programme was partly justified.

The Bill provided for farm prices to be subsidised by about $1,000 million. The President, by administrative action, is to subsidise prices by about $500 million. This is the crux of the struggle between the President and the Congressional opposition: whether farm income shall be subsidised at the Congressional rate or at the Administration rate.

The Administration is concerned with the problem of farm surpluses, which the President described in his veto message as ' price-depressing ', caused by ' wartime incentives too long continued '. On the other hand, the Congressional opposition is mainly concerned with the decline in farmers' incomes. It is estimated that farmers' total income from farm and non-farm sources has dropped 26% since 1947, whereas the total national income has increased by 36%.

Although the opposition in Congress admits that there is a problem of surpluses, it does not agree that it is the only, or even the most important, problem.

The Administration has therefore been mainly interested in cutting down production in order to reduce the surpluses, whereas the opposition has been trying to obtain larger subsidies for the farmers.

Writing in the *New York Herald Tribune* recently, Walter Lippmann said that the hazards of farming during the technological revolution now in progress have become a social obligation, in principle akin to the Social Security System which deals with unemployment and old age. He added: ' The enormous increase of agricultural productivity in this generation, even more than the high parity supports, is producing the great price-destroying surpluses. To eliminate these surpluses millions of acres now in wheat, corn and cotton will have to be taken out of production. This will mean that several million farmers will have to go off the farms. It is to slow up, to soften, to alleviate this painful human readjustment that the social security principle will have to be applied to farming '.

When it is applied, says Lippmann, it will no longer be necessary to maintain artificially high farm prices, for they are only an indirect and cumbersome way of subsidising farm incomes. It will be better to support the farmers' incomes on the principle of social security and to let prices become genuine as determined by the markets.

Atomic energy and agriculture

THE European Commission on Agriculture concluded its eighth session at the Rome headquarters of FAO in May. Highlight of the session, which met under the chairmanship of M. R. Braconnier (France), was the report on proposed activities to be undertaken by FAO in the field of atomic energy in relation to agriculture.

In presenting this report, Dr. R. A. Silow, FAO specialist in this field, pointed out the necessity for a world-wide study of the potential contributions of atomic energy to agricultural development, in which, he suggested, there is clear need for international co-operation. The Commission itself has already decided to establish a contact group on the uses of radiation and radio-isotopes, and 11 countries out of the 21 invited had now nominated members to it.

Reviewing the situation in Europe generally, as regards research into atomic energy in relation to agriculture, Dr. Silow said it is becoming apparent that certain countries are specialising in certain aspects of the many problems involved. Norway, for example, had begun to work on the use of radiations to extend the storage life of fruit and vegetables and had also, like Sweden, a comprehensive programme for investigations on radiation-induced mutations in farm crops. In Denmark emphasis was being laid on tracer investigations in a wide variety of agricultural problems. He said he believed that Germany has paid more attention than any other European country to meat preservation by irradiation.

Summing up, Dr. Silow said that it is evident that FAO has a much more important role to play than that of merely assisting in the exchange of information, and that FAO could well act as a focal point for stimulation, organisation and co-ordination of action in this whole field. In the meantime, the newly-formed contact group had a wide range of subjects with which to occupy its attention.

A REVIEW OF THE NYASALAND TEA INDUSTRY

D. H. LAYCOCK

(*Tea Research Institute, Mlanje, Nyasaland*)

Much progress has been made in the Nyasaland tea industry since the first abortive attempt to introduce tea to that area in the form of seeds in 1878. *In this comprehensive review the author outlines many of the difficulties that have been overcome and discusses some of the problems that have yet to be solved.*

THE earliest recorded attempt to introduce tea into Nyasaland was in 1878, when seeds of tea and coffee were brought from the Royal Botanic Garden, Edinburgh. Of the two, only coffee survived, but 10 years later a second attempt to introduce tea, this time as seedlings transported in Wardian cases, was successful and at the present time the area planted to tea totals about 26,000 acres.

Nyasaland's yearly production of about 17 million pounds weight of made tea is negligible in comparison with world production, estimated to be 1,350 million pounds weight, yet within the Protectorate tea is of prime importance. Its export value, as can be seen in Table 1, lies only second to tobacco; within the Protectorate the industry represents the largest amount of capital invested in any one industry and it is the largest single employer of labour.

At the time of writing, Customs data, only available to the end of September 1955, show that of the total domestic exports valued at £5,788,000 tea accounts for £2,683,000 and tobacco £2,036,000.

It is certain that tea will exceed tobacco in 1955.

TABLE 1
VALUE OF TEA, TOBACCO AND ALL PROTECTORATE EXPORTS EXPRESSED FOR CALENDAR YEARS 1950–54 (IN UNITS OF £1,000)

Year	*Tea*	*Tobacco*	*All Protectorate exports*
1950 ..	1,691	2,767	4,980
1951 ..	2,029	2,733	5,769
1952 ..	1,912	2,134	6,198
1953 ..	1,570	2,878	7,118
1954 ..	2,728	2,776	7,092
Total ..	9,931	13,288	31,157
Percentage	31.8	42.6	100.0

Climate and soils

There are two established tea-growing areas, separated by some 40 miles of country too dry for tea cultivation. Mlanje, the older area, accounts for slightly less than half the total acreage of mature tea and Cholo, the second area, accounts for the remainder of the mature tea and the larger proportion of the new plantings made since the end of the war.

In Mlanje district tea-growing is confined within a relatively level and compact area, eight miles wide and 20 miles long, running along the southern foothills of Mlanje Mountain. The mountain rises sheer from a surrounding plain to a plateau at a height of 5,000 ft. above sea level and 3,000 ft. above the plain. This massif affects the prevailing winds, causing a high and localised rainfall along its southern slopes, and it is to this that Mlanje tea owes its existence. The average annual precipitation is about 75 in., in comparison with 25 to 30 in. for the unaffected parts of the surrounding plain.

Cholo tea grows in a district of broken and hilly country 40 miles to the west of Mlanje, which is less compact than Mlanje and receives only 55 to 60 in. of rain per year. There is no large dominant topographical feature to benefit the whole of this area and Cholo mountain, small in comparison with Mlanje Mountain, affects only the area of land in its immediate vicinity. Cholo is climatically less favourably placed than Mlanje for tea-growing, but has larger areas of land left for planting.

The seasonal averages of 75 and 55–60 in. of rain are not high and bad inter- and intra-seasonal distribution

The laboratory/office block at the new extension to the Research Station

leads to a constant concern for the deleterious effects of prolonged dry spells. Some idea of the poor seasonal distribution and the extreme variability of rainfall can be gained from Table 2, which lists, for one station in each area, mean rainfall totals and their 90% confidence limits.

It is evident from these data that Nyasaland is climatically not an easy tea-growing country and especially is this true of Cholo. The crop season is taken to be from July to June, which corresponds with the middle of the dry season through the rains and into the following dry season. Over 70% of the seasonal total rainfall falls in the six months November to April and the cropping pattern is roughly parallel; 75% of the crop is taken in the same period. From May onwards the dry season increases in intensity, culminating in the almost-drought period of September, October and the first half of November, after which the main rains are expected. Temperatures over this drought period steadily increase, reaching and averaging over 90° F. for the last four or five weeks.

In both areas soils are basically lateritic in formation and in their virgin state are adequate for tea culture. Tea in both areas responds well to nitrogenous fertilisers and to date no known responses have been obtained from controlled phosphate or potash dressings, although a soil survey recently carried out suggests that these two nutrients might be reaching low levels in the older tea gardens. Organic content can be low and needs careful attention.

Mlanje soils are prone to cause a sulphur deficiency, the well-known 'tea yellows' disease, unless they receive sulphur additions. Adequate sulphur supplies are obtained from routine fertiliser dressings with sulphate of ammonia and superphosphate and the deficiency disease is now virtually no more than an unpleasant memory of early planting days.

A localised and novel condition exists in a copper-deficient soil found immediately under a part of Mlanje Mountain. Plucked leaf grown on this soil will not ferment during manufacture unless the bush is sprayed with a copper-containing salt (usually Bordeaux) at approximately two-yearly intervals. It is of interest to note in this connection that reference to a copper protein identified and concerned in fermentation was made in Ceylon in 1937.

Field and manufacturing methods

The factors contributing to superb quality of taste have yet to be explained in quantitative detail, but of empirical importance appears to be combinations of climate and soil type, in particular those that combine to produce a slow but healthy growth. Nyasaland lacks these two empirical essentials and aims, therefore, at producing as high a yield as possible of medium to good quality common tea. The Protectorate's average yield per acre, in spite of the poor climate, is good and is in the region of 700 lb. of made tea, although this figure does not reflect the wide range of yields that obtain. Most of the old gardens are planted with poor narrow-leaved varieties and these only average some 500 to 600 lb. per acre. Later plantings have been made with better large-leaved types, basically Indian varieties, and these gardens, although averaging only 800 to 900 lb. of tea, are capable, if well managed, of sustained yields of over 1,000 lb. of tea per acre.

It is evident that a 700-lb.-per-acre over-all average yield does not approach the maximum potential and much remains to be done to increase yields by using better field methods and by planting improved varieties.

Seed is harvested towards the end of the rains and consequently young seedlings have to survive the rigours of the oncoming dry season at a tender and immature age. These circumstances have led to the system of growing tea seedlings for the first 18 or 30 months of their lives in nurseries situated near to perennial water supplies, used for watering them during the dry seasons. Establishment from the nursery to the field proper is made by using 'stumps', which are seedlings pruned to 4 in. high immediately before uprooting in the nursery. No attempt is made to plant with soil attached to the root—all nursery soil being left *in situ* for further use. Successful field establishment requires great care and has been the subject of a series of experimental investigations.

Field treatments are many and variable and it becomes virtually impossible to describe in brief an average set which would be descriptive of either area. By and large the poorer varieties demand and respond to harder physical treatment than the better varieties. Thus the former are usually pruned each year, whereas the latter may only be pruned in alternate years or less frequently.

Fertiliser dressings are again variable, but an average might be placed at the use of 60 lb. of nitrogen, 15 lb. of phosphate (P_2O_5) and 15 lb. of potash (K_2O) per acre in the forms of sulphate of ammonia, superphosphate and muriate of potash respectively.

Plucking rounds in the early part of the crop season are usually excessively long as a result of early season labour shortages, although later in the season the position usually improves sufficiently to allow the maintenance of an optimum seven- or eight-day round in Mlanje and slightly longer rounds in Cholo, where growth is slower. Deep soil cultivation is no longer practised and it is true to say that the only usual

TABLE 2
MEAN RAINFALL, IN., WITH 90% CONFIDENCE LIMITS

Month	*Mlanje*			*Cholo*		
	Mean	*Lower limit*	*Upper limit*	*Mean*	*Lower limit*	*Upper limit*
Jan. ..	13.20	3.71	24.02	10.53	3.81	19.24
Feb. ..	14.30	4.60	27.56	9.24	3.86	17.48
Mar. ..	12.08	4.54	21.64	9.76	2.23	20.26
Apr. ..	4.61	0.20	12.13	3.41	0.64	7.16
May ..	2.53	0.16	8.46	1.65	0.14	4.66
June ..	2.04	0.33	5.07	1.60	0.20	4.25
July ..	1.21	0.03	3.75	1.37	0.08	3.39
Aug. ..	1.18	0.00	3.75	0.94	0.00	2.71
Sept. ..	0.70	0.00	2.33	0.59	0.00	1.90
Oct. ..	2.47	0.00	9.40	1.39	0.00	4.19
Nov. ..	6.67	1.65	14.78	4.58	1.26	9.29
Dec. ..	10.32	2.19	22.70	9.36	4.17	15.78
12 m'ths	71.31	49.54	93.08	54.40	35.01	73.19

soil disturbance is that incidental to surface hoeing of weeds. Weed growth and its control, although not a problem under well-grown mature tea, can be, and frequently is, a major problem in newly planted immature tea where early season weed growth outpaces the inadequate labour supplies at that time.

The industry is, on the whole, fully aware of the necessity for soil- and water-conservation methods and all tea, including the oldest fields, is contour bunded.

New plantings and replantings of old areas are always made nowadays with the better Indian varieties of seed, although these are of mixed parentage and leave much to be desired. The prohibition on the import of Far Eastern seed, consequent upon the appearance there of blister blight (*Exobasidium vexans*), has forced Nyasaland into its own selection and variety improvement programmes. A voluntary seed selection and purity testing scheme, sponsored by the Research Committee, was accepted by the industry and started in 1955. If used properly, this scheme should do much to encourage the selection and availability of better varieties.

Only a very small proportion of the total mature tea is under leguminous shade trees. A slightly higher proportion is planted to *Grevillea robusta*, although the morphological shape of this tree places it more correctly in the category of a wind break rather than a true shade. On the research station tea shaded with the leguminous *Albizzia gummifera* has over the past five years out-yielded its unshaded counterpart by 33%.

There is little doubt that much benefit can be obtained from carefully used and well-managed overhead shade and estates are establishing trees over increasing areas every year.

Manufacturing methods are, on the whole, orthodox and do not vary as much between estates as do field methods. Most factories are mainly built after the Ceylon pattern with overhead withering lofts and the usual array of machinery in the machine rooms below. Potentially useful and interesting innovations are being tried out by some estates, particularly in overcoming the disadvantages inherent in orthodox loft withering. Thus it is possible to see specially built withering houses of new designs with controlled heat and air flows. Within 12 months two estates will begin to assess the value of mobile tats and drum withering and, most unorthodox of all, one estate is at present experimenting with the deep-freezing of leaf.

A typical Nyasaland tea factory. Withering lofts occupy the top three stories and tea-making machinery is housed on the ground floor

On a well-balanced estate about one-third of the equivalent tea acreage is growing timber for fuel, usually *Eucalyptus saligna*. Economically this is not an efficient use of potential tea soil, particularly so when the total area suitable for tea is limited by shortage of land of suitable environment in the area. There is, therefore, a definite search for alternative sources of fuel, and coal and oil are already being used by some estates. Economies in fuel consumption are reported from a number of estates who have turned to the method of using excess steam from the prime mover to provide heat for drying. Whether or not a supply of electrical power from a possible use of the water resources of Lake Nyasa would be welcomed by estates remains to be seen and in the end the decision would naturally be based upon the cost per unit of the power supply.

Pests and diseases

Nyasaland tea is, as a whole, free from serious diseases. It is possible that the frequently maligned annual dry season is, in fact, largely responsible for this immunity, in that for four months in each year an increasingly dry climate occurs which cannot be conducive to the survival of stem- and leaf-attacking diseases. It is not surprising that the most troublesome diseases are soil inhabitants, with *Armillaria mellea* at the forefront. Control of this disease is effected by ring-barking forest trees before clearing, although it cannot be said that estates are always as efficient as they should be in this respect. Other soil-borne diseases occur, particularly in nurseries, but so far they have never been more than localised nuisances.

Pests are more troublesome than diseases. Mosquito bug (*Helopeltis bergrothi*) appears every year in sporadic patches of fair severity, but control can be effected with DDT sprays and by attending to the control of grass and undergrowth. Termites are a major pest, particularly in new plantings, but encouraging advances have been made over the last 18 months with the use of Dieldrin and Dieldrex.

Labour supply

Financial and climatological considerations aside, the greatest single difficulty facing the industry is its labour supply, both in quantity and quality. Unlike the Far Eastern worker, the African does not as yet regard tea culture as a skilled and traditional

family occupation and, apart from small numbers of permanent and skilled men to be found on all estates, the majority of field labourers stay only a few months at a time on any one estate. His roots are still in his village, which under his tribal ties offers him a maximum of security (albeit only at subsistence level) for a minimum of effort. In spite of increasing wages and increasingly better working and living facilities, the majority of the labour supply remains itinerant and it is not unusual for estates to show a 200% turnover on the labour roll for any one season. In these circumstances only slow progress can be made at present towards building up skilled and permanently settled labour forces, which are so essential if the increasing costs per labour unit and out-turn are to be successfully combated.

Equally disturbing is the lack of responsible supervision midway between the European and the labourer. The majority of African foremen lack an inherent or an acquired sense of true responsibility either towards their labour gang or towards their employer and they have not yet developed the persistence or character necessary to maintain authority by example. The result is a near vacuum between the European and the labourer, neither truly understanding the other, and this does little to help overcome the difficulties already mentioned.

Standards of field work are consequently low. Acute seasonal shortages of labour occur, particularly at the beginning of the rains and during the first crop flush in November and December, at which time the potential labourer is still preparing and planting his village garden. Labour problems are, therefore, a constant source of worry (and investigation) and make the job of supervising a tea estate one of frequent anxiety and frustration.

Nyasaland Tea Association

An association of planters was first formed in 1929 for the purposes of initiating research into the cultivation of tea. In 1936 this became the Nyasaland Tea Association, with headquarters in Blantyre, and broadened its terms of reference to include the promotion and protection of all internal and external matters affecting the well-being of the industry. Its funds accrue from a self-imposed cess on exported tea and it is the sole body which speaks officially for the industry and is recognised by Government as such.

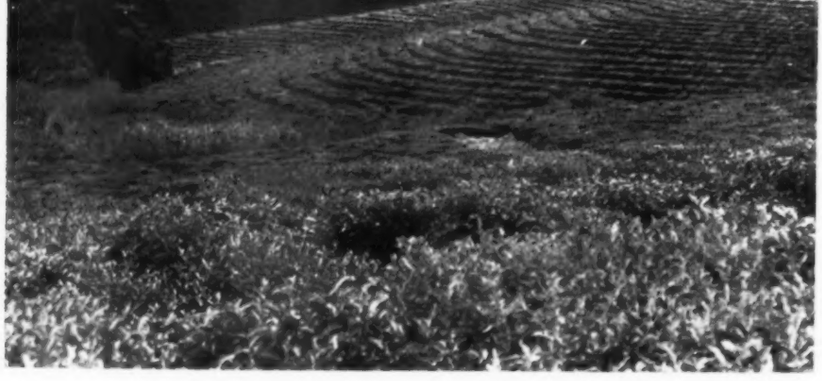
Experimental work

It is true to say that the tea industry has always been aware of the necessity for sound advice being offered from a basis of research and experimental work and the industry has since the early thirties been most encouraging and helpful towards the research station.

At the turn of the century 17,000 acres of coffee were under cultivation, but disaster followed and by 1925 all except 850 acres had been decimated by pests and diseases. This depressing atmosphere surrounded the young tea industry when it faced its first pathological alarms in 1927 and it promptly persuaded the Government to take action, resulting in a visit by Dr. Butler in 1928, which, in turn, led to the appointment of R. L. Leach to the Department of Agriculture with priority duties towards tea diseases. During 10 years of brilliant work he was associated with the problems of sulphur deficiency, the root disease *Armillaria mellea* and demonstrated that stem canker of tea was due to the damage of the mosquito bug (*Helopeltis bergrothi*) and not to a pathogenic fungus, as was previously held. At the same time he cleared land for and opened up the first of the research stations. Leach resigned in 1938, when the first of his field experiments were beginning to yield results; less than a year later the war started and for the next 10 years no officer was available solely for tea research. In 1949 the staff situation had eased sufficiently to allow a full-time officer to be appointed once more and since then the resident staff has been increased to four.

During the war it became evident that the 35 acres of tea on the station would be too small to allow of the necessary complex experimentation if the interplay of the major management methods was to be studied. A large area (650 acres) of land, six miles from the old station, was therefore purchased by the Government and it is here that all new experiments are being planted. The formal opening of this new extension took place in September 1954.

Unlike the Far East, the Nyasaland acreage is too small to allow it to support its research facilities by a proportionate tax levied on the industry. The Government provides staff and recurrent expenditure and the industry, through the Tea Association, has made large financial gifts for capital expenditure. A Tea Research Committee is responsible for the overall planning of research and consists of four officially appointed members and four appointed by the industry. Under the guidance of this Committee research has turned away from the emphasis on pathological problems to the less spectacular and more tedious comparisons of the long-term effects of field-management methods and in the immediate future will concentrate on a variety-improvement programme. A five-year programme of expansion in the field was



Unshaded tea in the Cholo district, showing the use of soil- and water-conservation contours

completed with the 1954–55 planting season and at the new station there are 70 acres of young tea, 45 acres being already under experiment.

Although full returns from these new experiments will not be available for many years to come, some important gains have been made during the last five years. The underlying laws concerning the successful establishment of newly planted tea are now better understood and estates are benefiting from this knowledge. Responses to fertilisers with mature tea are becoming clearer and the time of fertiliser application, be it during the climatic season or during the pruning cycle, is proving to be of importance, both results leading to more firm advice being given than was formerly possible. Empirical observations upon the beneficial effects of shade, the benefits to be obtained from improved planting material, the use of the newer pesticides and so on, to mention but a few of the matters under investigation, have all had their returns in advisory work.

A variety-improvement programme is already planned and, although this is inevitably a long-term project, much is hoped for in the near future by the voluntary seed-certification scheme which is now under way.

Financial considerations limit the diversity of experimental work that can be attempted and to date no work is being done on manufacture.

The future

The amount of land available for expansion in the two established areas is limited. Planting of the remaining unplanted land and uprooting and replanting of old unproductive gardens is under way at an increasing pace. Areas in the north of Nyasaland offer possible scope for future expansion and a few small plots of tea, established some years ago, lend encouragement to its suitability. One freehold area in the north has recently been purchased and is to be developed under tea.

Meanwhile much remains to be improved in the two established areas. High up on the list is the necessity to solve labour problems and both the Government and the Tea Association are constantly attempting to find an answer. Largely as a result of research, greater care is being shown with the establishment of newly planted tea, larger quantities of fertiliser are being used on mature tea and an increasing interest is being shown in the use of overhead shade trees. Many basic questions are still unanswered and time alone can fill in these gaps.

A view of tea in the Mlanje district with part of Mlanje Mountain in the background. Note the use of Grevillea robusta *as a shade tree*

Nyasaland is not an easy country in which to grow tea; nevertheless, the industry is vigorously optimistic and by being of essential importance to the Protectorate's economy its future, as far as can be predicted, appears to be bright.

Photos: p. 255, E. W. Hill, Ruo Estate, Mlanje; all others, Federal Information Dept., S. Rhodesia.

IFAP Anniversary

The Ninth General Conference of the International Federation of Agricultural Producers (IFAP) will be held at the University of Purdue, Lafayette, Indiana, in May 1957.

The top-level meeting, which will bring together hundreds of farm leaders from all over the world, will be held from 20 to 31 May. IFAP is a world farm organisation representing 35 million farm families in 26 countries. The organisation acts as the international spokesman for farmers around the world.

' It is fitting that we should meet in U.S.A. at this time ', Roger Savary, IFAP Secretary-General, said. ' The U.S.A. has become the centre of the world so far as agricultural policies are concerned. Every action taken in Washington not only affects American farmers, but affects the pocket books of farmers everywhere in the world, from Iceland to New Zealand '.

Big Spraying Project

What is believed to be the biggest spray irrigation plant in Australia has gone into operation near Cowra, in the central west of New South Wales. It is capable of watering 250 acres.

The equipment waters 7½ acres a day, giving each acre the equivalent of 6½ in. of rain. The water is pumped from the Lachlan River by a 6-in. centrifugal pump, powered by a 60-h.p. electric motor capable of supplying 700 gal. a minute to 240 acres of established lucerne.

The water is pumped into 75 chains of 10-in. underground mainline with outlets 208 ft. apart. The mainline is joined by 75 ft. of 5-in. aluminium submain, which feeds into two 17½-chain lengths of 5-in. aluminium spray lines. Each length of spray line is fitted with 27 sprays.

The lucerne under spray irrigation is yielding seven cuts, each of 1 ton to the acre, each year.

STYLOSANTHES GRACILIS AS A GREEN CROP IN TEA

R. I. MacALPINE

(*Indian Tea Association, Tocklai Experimental Station, Cinnamara, Assam, India*)

In this short note the author outlines some of the experiments that have been undertaken with Stylosanthes gracilis *in an endeavour to ascertain whether or not it will have any beneficial effects when grown in conjunction with tea. The author concludes that, although ' Stylo ' is not likely to be the answer for mature tea, it offers distinct advantages as a ground cover crop in young tea.*

WITHIN the last year or two *Stylosanthes gracilis* or, as it is commonly called, ' Stylo ', or sometimes ' Brazilian lucerne ', has received considerable publicity as a nitrogen-fixing legume green crop for tea.

Stylosanthes is a genus of the Papilionaceae, a sub-order of the Leguminosae, but is not indigenous to this country (Assam), having, it is understood, been imported from the South American continent.

It has recently apparently been extensively used in Ceylon and South India. Last year a number of estates received brochures on the species from certain seed suppliers in South India recommending its use in tea.

Growth habit

In cultivation in West Bengal it attains a height in the open of from 3 to 4 ft. and under such conditions forms a dense mat of vegetation over the ground. Individual plants arise from a central root stock and produce a great number of runner-like branchlets more or less at ground level. Most of these branchlets when mature throw out adventitious roots at the nodes, but, at least under conditions in which it has been grown in the Darjeeling district and the Dooars, these runners do not root naturally.

The resulting growth form is thus that of a scandent shrub. A feature thereof is that the plant with its tangled mass of branchlets can literally be ' rolled up ' like a carpet.

Under even moderate shade it tends to push up into the overhead canopy and becomes somewhat straggly. In a plot at Nagrakata, where it was established under *Boga medeloa*, the plants have attained a height of as much as from 5–6 ft. and have used the Boga for support. Under heavy shade it becomes extremely attenuated and if it cannot get into the light is suppressed.

Tocklai experiment

The species is evidently, therefore, a strong light demander.

' Stylo ' first came to the writer's attention in 1949 through the medium of an agricultural journal from Ceylon, wherein it was highly praised as a fodder crop for cattle, both for cutting and for introduction into grazing grounds. It was stated to be a high yielder, could stand heavy cropping and is a perennial.

Some seed was obtained in 1949 from Ceylon and sown in March 1950, both at Kurseong, in the compound of the Advisory Officer's bungalow and in an estate in the Darjeeling area, however, in this case at a medium elevation.

At Kurseong growth was excellent and the area in which it had been established was virtually completely covered by the end of the first rains, but in January a somewhat severe frost hit the locality and the plants died. In the tea garden it grew even better and survived the following hot weather excellently. It was intended to use cuttings from this crop for trial in tea, but through various circumstances this was not done and in due course the area was lost sight of.

Transplanting basket with young tea plant. Travancore, S. India

Further seed was obtained and put down in prepared ground at Borbhetta at Tocklai in 1952. By 1953 it had established itself fully in a thatch area, where its potential weed-suppressing powers could be readily observed.

In 1953 seed was sown in an area adjoining the compound of the Advisory Officer's bungalow at Nagrakata. Again it flourished and by the end of the rains attained sufficient development to produce a great quantity of cutting material.

Cuttings were put down as a trial in September 1954 and established themselves with very little attention, though they did not put on much growth until the following spring.

Boga medeloa

In the spring (May) of 1954 cuttings were again put down, this time both in an area with established *Boga medeloa* in lines and in the open. The method adopted in the Boga area was to set the cuttings along both sides of the lines of Boga and some 6–9 in. away from the Boga plants. It was considered that as Stylo was evidently a strong light demander, providing the Boga shade was not too dense, it would tend to spread into the area *between* the lines of Boga; that is, in the area where normally tea seedlings would be planted. This is, in fact, exactly what happened. The Stylo generally spread outwards into the interspaces, but it was found necessary to reduce the overhead Boga shade considerably by lopping and trimming of side branches to prevent it closing over the top.

In an area without overhead Boga shade cuttings set between May and July struck readily and once again by the end of the rains had covered the ground.

In March the latter area was sickled over for seed collection to about 12–18 in. above ground level. Even with the removal of a considerable mass of foliage a tangled mat of branchlets was still left on the ground, which, in the course of trampling, formed a more or less complete mulch over the area. During this operation the value of the crop in respect of its effect on the soil became very noticeable. The ground was covered with a dense layer of rotting vegetation, was relatively clean of weeds, and was quite moist—this, it should be remembered, was in a drought year. Further, although Bagrakote jungle and thatch in other areas was by now quite dry, the Stylo up to the time of cutting was still relatively green.

Young tea nursery, Travancore, S. India

In a certain dairy farm in the Kalchini district Stylo has been grown for cattle fodder and has, it is understood, proved a great success. Elsewhere in various estates seed has been sown in prepared beds for multiplication of both seed and cuttings material. It appears to grow well, therefore, in a variety of localities.

It will be observed from the above that none of the trials discussed has hitherto been made in tea. This, it is hoped, will be done next year (1956), but until it is actually tried out in the field on a commercial scale it would be unwise, on present experience, to recommend it for universal use.

Use in tea

From observations so far, however, the following factors emerge and perhaps may be used as pointers to its employment in tea:

1. As it is a light demander, it is not likely to be successful as a ground cover crop in closed, canopied, mature tea. Even in relatively open tea it may not be entirely desirable in view of its tendency to push up into bushes. Admittedly the species is easily controlled by sickling, but how often this will be necessary during the season will have to be worked out in practice.

Stylo should be a very useful ground cover for terrace faces in Cachar and Darjeeling. It should help to keep the exposed faces covered and to prevent erosion, as well as fixing nitrogen.

2. For young tea its luxuriant growth, weed-suppressing potentialities and its nitrogen value would appear to make it a species worthy of establishment in advance of planting up. Its growth habit of arising from a central root stock and the fact that it is a perennial permit of it being retained in the field after the tea has been planted out.

If the method indicated above of dibbling cuttings in alongside the lines of the high green crop is employed, there will be little hindrance to planting out operations, for the Stylo can either be ' rolled back ' on to lines of the high green crop and replaced after planting out is completed, or it can be sickled, the litter from this operation being used for mulching the tea.

3. As long as adequate light is provided the Stylo will remain more or less a ground cover crop and it will thus be necessary to ensure that the high green crop does not close as an overhead canopy. This can be done by lopping and trimming of side branches, as is normally done in treatment of green crops in young tea, though it may also be necessary to control exuberance of growth by sickling, as otherwise the tea itself may be suppressed.

This is likely to be particularly necessary when young tea is pruned, as lateral development may be hindered by letting the Stylo get out of hand.

4. By virtue of the fact that Stylo is a light demander, it is not likely to persist when the tea closes up, but open spaces are likely to continue to hold the crop. There may be a stage, however, in the life of the plantation when the Stylo is likely to straggle and push up into bushes, namely, in the year or two before the tea closes up, and control will have to be effected.

5. As Stylo is a ground cover crop, it will not afford overhead shade to young tea and a high cover crop will have to be used in conjunction with it for this purpose.

That the species may have disadvantages is evident from the foregoing observations. Trial in the field will show whether these disadvantages are outweighed by the advantages.

The search for an efficient, easily controllable ground cover crop for tea has been going on for years. On p. 93 of Cooper's Memorandum No. 6, ' Nitrogen Supply to Tea ', it is stated in relation to permanent low-growing cover crops:

' The suggestion sounds very attractive that tea land should be kept permanently occupied by a low-growing leguminous plant, to enrich the land, prevent soil erosion, and reduce necessity for cultivation. Unfortunately no plant has yet been found which is low enough not to interfere with plucking and will remain healthy under tea '.

Stylo is not likely to be the answer in mature tea, but the writer is firmly of opinion that among the large number of leguminous plants of this nature which he has observed and tried out, Stylo, used with discretion, and with the acceptance of the fact that it will have to be controlled, offers so far the best chances of success as a ground cover crop in young tea.

This article was reprinted, with permission, from *Two and a Bud*, 1955, **2**, (No. 4).

Chinese Irrigation Scheme

A 55-mile-long reservoir, which will irrigate 50,000 acres, was opened recently in Szechuan Province, South-West China.

Bracken Destroyed with Rotary Cutter

The 6-ft., p.t.-o., Rotary Grass Cutter, manufactured by Hayter's (Sales) Ltd., Spellbrook, Bishop's Stortford, Herts, England, took part in a demonstration recently. In the top photograph the machine is shown cutting through thick bracken and brambles many feet high. The bottom photograph shows the final result. This result was achieved in conditions of almost continuous rain

Stapleford Forestry Development

Sound forestry practice in catchment areas tends to even out the flow of streams by preventing big ' flashes ' and giving a longer duration of flow, Mr. G. M. McGregor, Assistant Commissioner of the Forestry Commission (Federation of Rhodesia and Nyasaland), said at Stapleford, near Umtali, recently. He was addressing the Eastern District Group of Intensive Conservation Area Committees on the implications of forestry in relation to water conservation in rivers and streams. In 1959 Stapleford will finish a complete 30-year cycle. When the block is felled it will be possible to give accurate figures on the economics of tree-planting. At the moment such figures can only be based on thinnings. The sawmill at Stapleford is the biggest in the Federation and one of the first three in South Africa. The mill is now being expanded and when the work is complete it will be able to handle 1,750,000 cu. ft. of wood a year.

COMMERCIAL SELECTION AND BREEDING OF TEA IN INDIA

W. WIGHT

(*Indian Tea Association, Tocklai Experimental Station, Cinnamara, Assam, India*)

In this detailed account of the tea selection and breeding methods in India the author deals with such subjects as regional variations, the influence of commercial seed in Assam, the selection of clones and other methods for obtaining improved tea seed.

IT is the current practice of systematic botanists to place all tea plants in the species *Camellia sinensis* (L). From this it must not be supposed that all tea plants are similar: differences in size of plant and size and shape of leaf are well known, but these remain unsatisfactory features on which to base a nomenclatural system, in spite of much writing to the contrary.

Morphological forms can be defined by features such as size of disk, nature of stigmatic surface, position of cataphylls on the pedicel, glossiness and pigmentation of the leaf. Defined in these, and similar, terms, relatively true breeding forms of tea are known. For instance, plants of the large-leaf tea commonly referred to as var. *assamica* include forms with ovaries either like that shown in Fig. 1 or in Fig. 2.

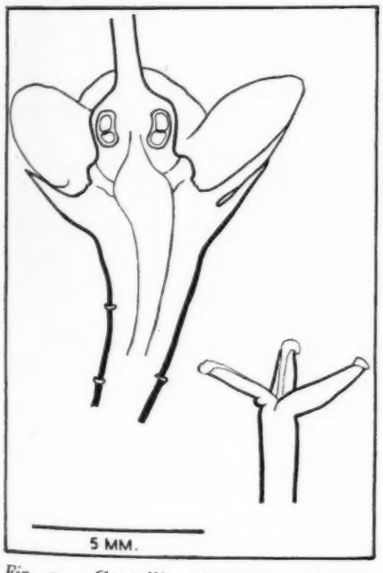


Fig. 1. Camellia sinensis. *Ovary associated with non-pigmented glossy dependent leaf with distinct marginal veins, often bullate*

Natural populations associated with disparate localities are characterised by one or other form of ovary. The ovary in Fig. 2 is associated with pigmented foliage. Tea made from plants with pigmented foliage and an ovary as Fig. 2 would be described by the taster as having a *thin liquor* lacking in *briskness*. These illustrations are not to be regarded as selection criteria, but as an example of an important association of features that will often breed true.

Further description is beyond the scope of this article, and it is merely pointed out that it is possible, in favourable circumstances, to recognise relatively true breeding forms similar in nature to forms previously described by students of tea.[1] The populations usually seen in cultivation give the impression of an unclassifiable mass of intergrades, but this seems to be the result of hybridisation between genetically important forms, the nature of which have been indicated.

Tea is manufactured from these variable populations (raised from seed) and, as not less than 10 acres of bushes will yield sufficient shoots for a single manufacture, one's concept of kind of plant becomes that of kind of population and is used in this sense in subsequent paragraphs. Any definition of the plant population must depend upon the frequency occurrence of specified morphological features. It follows from what has been said of genetically important forms that disparate populations—or, loosely speaking, different kinds of plant—will be associated with the manufacture of different kinds of tea. This has not been fully appreciated by tea planters, who have too often ascribed the nature of the tea solely to local soil and climate—or to equally irrelevant conditions of manufacture—to the exclusion of genetical factors of primary importance.

Regional variation of tea and tea plant

Morphological differences can be recognised between three not very widely separated tea-growing regions of North India: the Brahmaputra valley ('Assam' valley), the Surma valley to the south of the Khasi Hills, and the Dooars to the south of Bhutan. For instance, the percentage of plants with pubescent leaf and pigmented petiole was estimated and the results are shown in Table 1.

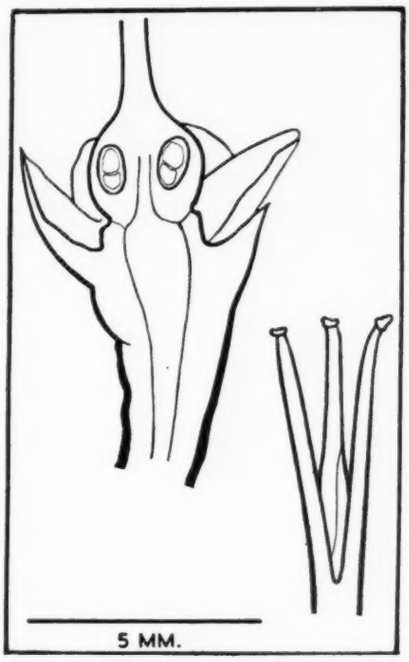


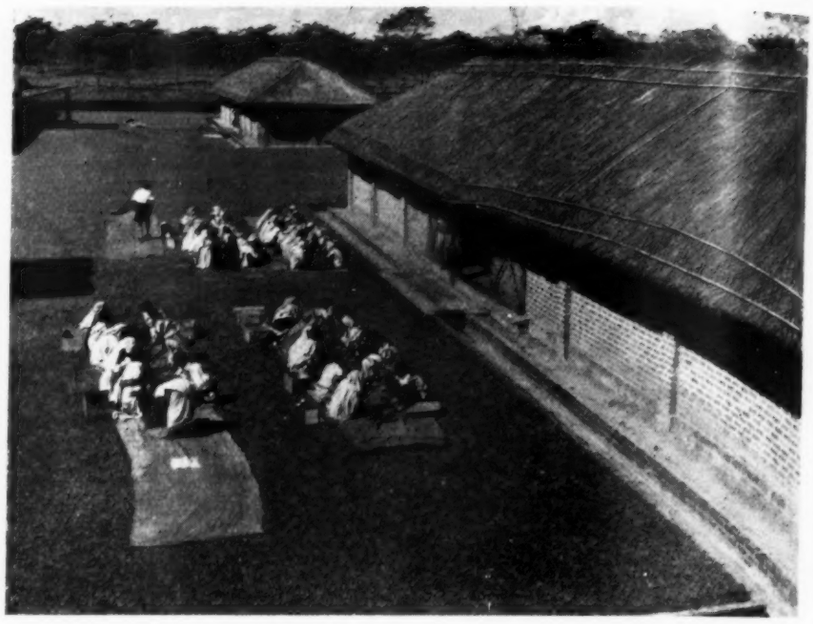
Fig. 2. Camellia sinensis. *Ovary associated with more or less pigmented glossy leaf, not dependent, without distinct marginal vein, not bullate*

TABLE 1
REGIONAL VARIATION IN PERCENTAGE OF PUBESCENT AND PIGMENTED PLANTS

	Pubescent	*Pigmented*
Brahmaputra valley ..	8.6	16.4
Dooars ..	2.4	9.8
Surma valley	0.3	7.0

These differences were associated with differences in the market value of the tea that are well known to the planters concerned.[2] The morphological differences may be ascribed to various reasons, such as introductions from different sources, differential survival of the introduced material and conscious selection by local planters.

There is a more generally known association of kind of tea with more widely separated regions; for instance, Ceylon tea is known to be different from Indian tea, but it is less generally known that some of the tea made in South India resembles that from Ceylon. Tea from Darjeeling in North India has a distinctive flavour. Tea from the Indian province of Assam is different from tea made anywhere else in the world and is characterised by the attributes known as strength and pungency (for the purpose of this article we regard pungency as the maximum development of briskness); this tea is made from a kind of plant indigenous in Assam. These several kinds of tea have different markets; for instance, there is a great demand for Darjeeling tea on the continent of Europe, but in other places the consumer is best pleased with a blend of tea from two or more regions.



[Courtesy Tea Board, India]

Fig. 3. Seed stores of a well-known tea-seed company

It is of interest to note that the tea plants of South India have affinities with those of Ceylon and are different from those of Assam, whereas the plants in Darjeeling differ from either of these regions. Plants that have been selected as desirable in Ceylon by Ceylon standards are genetically similar to plants that are incapable of making the Assam kind of tea when growing in Assam. Traces of Darjeeling flavour can sometimes be detected in Assam in plants that are similar to those grown in Darjeeling.

Adequate knowledge of environmental factors has yet to be obtained, but the evidence suggests that a regional kind of tea is inherent in a kind of plant and can attain the full development of its attributes only when the plant is grown in certain regions. Thus a limited number of regions are likely to best produce a particular kind of tea and, whereas the regional kind of tea might be changed, the change would not necessarily benefit the grower. For instance, the Assam kind of plant could be grown in Darjeeling and might yield tea of the Assam kind, but this would not satisfy a market demand for Darjeeling tea, neither would the Assam plant be likely to live as long in Darjeeling as the plant usually cultivated there.

The life span of the plant determines the long-term management of a tea plantation. A short life span could nullify the advantage of high yield. There is experimental evidence to show that morphologically distinct tea populations differ in their survival value under given conditions. This difference in survival value is likely to be

[Courtesy Tea Board, India]

Fig. 4. Every tea seed is examined by hand

modified by the various local conditions under which tea is cultivated; these factors, therefore, should be considered before changing the kind of plant that it is customary to cultivate.

Influence of commercial seed in Assam

A notable feature of the tea industry in Assam is the existence of companies and estates engaged solely in the production and sale of tea seed. Special facilities (Figs. 3, 4 and 5) and the experience of these companies ensures that the customer will receive uniform seed, free from disease and of a high germinability.

In the Brahmaputra valley these concerns have been using increasingly critical mass selection for nearly 50 years. Special attention has been paid to the indigenous plant, with the result that seed from one or two companies produces very distinctive plants (Fig. 6).

The tea made from these selected plants has the special qualities that have come to be regarded as typical of Assam tea. This tea is produced nowhere else and is in considerable demand; and so the plants previously cultivated are being steadily uprooted by all progressive concerns and replaced by the newer, selected material, characteristic of the provinces. Table 2 illustrates the improvements that have been made by commercial seed growers in Assam.

[Courtesy Tea Board, India]

Fig. 5. Grading tea seed for size

[Courtesy A. Watson, Esq.]

Fig. 6. Improved form of the Assam tea plant sold by a well-known tea-seed estate. Plant 21 months from seed, growing as a supply or infill amongst mature tea bushes

Seed and seedlings from a specified source—as the orchard (*bari*) of a seed company—are known as a *jat*. Each jat receives a distinctive name which specifies seed source without defining the plant in any way. As different jats with distinctive names may be morphologically identical, it is most important that jat differences are not confused with differences of kind.

Selection of clones

Small-scale experimental manufacture shows that bushes from a common seed source (all of one jat) differ very greatly in the nature of the tea that is made from their shoots. This applies especially to the modern jats now cultivated in Assam, which contain a small proportion of plants capable of making tea of an excellence hitherto unknown to the trade. This desirable tea is combined, in a much smaller number of plants, with satisfactory vigour and yield, and some of these plants will be comparatively easy to propagate vegetatively.

The quality of the tea, as initially observed, is nearly always maintained in the plants subsequently raised by vegetative propagation. Yield is not always maintained: some of the selections, however, will result in clones with a real and considerable increase in yield. Thus without waiting for the uncertain outcome of breeding immediate advances are possible by vegetative propagation by methods already described.[3]

Selection is based upon yield, estimated as number of shoots removed from *unit area of bush surface*, and upon pubescence, which gives a bias in favour of the particular quality required in Assam tea.[2] This selection is followed by miniature manufacture of shoots from the chosen bushes, tests of rooting ability of cuttings, preliminary yield of small clones and, finally, the trial of a reduced number of clones in larger experimental plots.

It is estimated that 40,000 bushes, or approximately 14 acres of tea plantation, will, on an average, provide one easily propagated clone with improved quality and cash value. The following

TABLE 2

NATURE OF 36 REPORTS BY A TASTER ON THE QUALITY OF TEA MADE FROM WILD AND SELECTED PLANTS OF THE ASSAM VARIETY: FREQUENCY OCCURRENCE OF FOUR CATEGORIES OF REPORT

Quality	*Wild tea of Assam*	*Selected jat of Assam tea*
Poor . .	28	2
Good . .	5	14
Better . .	3	16
Best . .	0	4
Relative yield	100	156

TABLE 3

LONDON VALUATION OF TEAS MADE ON 29 JULY, 1953, FROM ONE OF THE BEST ASSAM JATS AND FROM A CLONE SELECTED FROM A CLOSELY SIMILAR JAT. YIELD OF THE CLONE IS NOT LESS THAN THAT OF THE JAT

Grade of tea	*Jat*		*Clone*	
	Grade as % total	*Sterling valuation*	*Grade as % total*	*Sterling valuation*
		s. d.		s. d.
FOP	9.9	5 6	15.5	7 0
OP	18.8	4 3	20.7	5 0
FBOP	19.4	6 0	15.8	8 0
BOP	33.1	4 3	32.3	5 0
Fngs	15.0	3 9	12.6	4 6
Dust	3.8	—	3.1	—

report (Table 3) refers to one such selection. The high proportion of Flowery Orange Pekoe made during the monsoon period is to be noted; a similar proportion can be expected from any properly selected clone.

The number of good bushes may seem small, but this makes the clones of proportionately greater value; and when one considers the many thousands of acres of tea plantation in India, then it becomes evident that important improvements can be made very rapidly.

We do not, however, suggest that vegetative methods will supersede seed propagation. Large areas of clones may be feasible only in some regions. Possibly a limited number of specialist gardens might become entirely clonal and could maintain an advantage over gardens planted from seed, but in most instances the use of improved seed for planting the greater part of an estate would be desirable, and this, at the moment, is the only possible policy, because there has not been sufficient time to build up selected clones to a size large enough to supply cuttings to replace the seed required for the normal replanting programme of an Assam estate.

The immediate object of this work is to plant one complete section of an estate (10 to 30 acres) with a clone that yields a high proportion of the best grades of tea. Many of these clones have the unusual property of maintaining some flavour throughout the monsoon period. Later one-sixth of the plucking area of an estate (one day's plucking) could be divided between three to five clones.

Many clones have subtle characteristics, recognisable by the taster, which may distinguish the clone and give it special market value. Thus local selection by companies and estates can set new standards of 'scarcity value' likely to attract the attention of foreign buyers interested in good tea.

Local selection is considered in India to be of prime importance. The whole of this work is done on tea estates under the direction of the manager with technical advice from the Tocklai extension (advisory) staff when necessary. One company, in the course of 10 years, has maintained an average output of one valuable clone per year. This has been done by the company scientific officer with a modest field staff. The only work not done on the estate is the tasting of experimental samples of tea—these are made on the estate and sent to Tocklai for report.

Improved tea seed

Mass selection succeeded in producing modern Assam seed because the morphological features that appeared desirable happen to breed true and because they are linked with a pungency and flavour that make the tea unique. This must have been known to the enthusiasts who commenced the work, but their attempts to introduce the qualities of Assam tea into more hardy kinds of plant, by deliberate crossing followed by mass selection, did not succeed. This failure has been followed by the use of modern jats in situations that would be better suited to hardier kinds of plant.

[Courtesy Tea Board, India]

Fig. 7. Old tea bushes used as rootstocks for selected material

Thus an important task of the breeder is to introduce the characters of Assam tea into other kinds of plant adapted to a wider range of conditions. Mass selection will not suffice for this; line breeding, leading to vegetatively propagated clonal source of seed, is necessary.

As soon as a progeny is produced in which the plants are not too heterogeneous to make the pruning of large populations troublesome, and as soon as the shoots plucked from the entire progeny and manufactured together make a tea that is better than usual, then a new standard has been set that can be exploited commercially, provided that the yield is not lower than that which obtained previously.

Reciprocal matings generally give identical results; most tea plants set very little seed with their own pollen, some none at all, and thus, if suitable clones are used for the production of an experimental progeny by controlled or artificial pollination, then a substantially similar progeny could be expected to follow the free transfer of pollen when the two clones are interplanted, provided that the orchard so constituted is isolated from foreign pollen. Although this has yet to be demonstrated, the immediate object of tea breeding remains a bi-clonal source of seed, and with this end in view numerous experimental matings have been made during the past 16 years.

Morphologically distinct plants selected from estates and from introduced material have been used. It is estimated that these selections can lead to useful improvements in three generations. The main requirement is first-hand knowledge of the breeding behaviour of particular plants; for instance, some plants are useful pollinators for a wide range of material. Depending on the nature of the parents used for the initial mating, the first generation might be satisfactory, but further matings might be needed to

ensure that the final progeny originates in parents that are easy to propagate vegetatively (see Figs. 7, 8 and 9).

The usual time required for one generation, including the manufacture of shoots from individual plants, is about seven years, but it is sometimes possible to halve this period if rapidly maturing plants can be judged on morphological criteria and if they are required only as pollen parents. It is not always appreciated that one tea plant, even after seven years, is unlikely to produce sufficient seed for the next generation. Vegetative multiplication of selected plants is nearly always necessary and time can be saved by grafting the selected material on to old rootstocks: the scion behaves as if of the age of the stock and seed is produced at least two years earlier than from material multiplied by cuttings. Figs. 7 and 8 show controlled pollination of scions grafted on to old tea bushes. So far all experimental progenies have been obtained by this method, as it enabled us to make large numbers of matings with an efficient output of seed in the very small area originally allocated to the work. Unfortunately, the skilled labour that made this possible is no longer available.

[Courtesy Tea Board, India]

Fig. 9. Tea flowers and seed. In north India seed ripens in October, some in November. Flowering begins in November, ends early January

Statistical results

Fig. 10 illustrates the nature of the tea made from 10 progenies. The figures are constructed from tasters' reports in the following way: the adjectives used by the taster to describe the tea are grouped into four categories —poor, good, better, best—and the frequency occurrence of reports within each category is recorded. Thus the vertical height of the columns gives the relative frequency of reports in the four categories in order of merit from left to right. The same procedure is followed for three attributes of the tea and for cash valuation. The control is a modern Assam jat of the highest quality. Positive bias of the polygons relative to the control indicates improvement.

[Courtesy Tea Board, India]

Fig. 8. Controlled pollination of tea flowers

Homogeneity

Two important features of these matings are the homogeneity of plants within a progeny and diversity of type between the progenies. Thus there are reasons for believing that the progenies will be severally adapted to various environmental conditions. The yield of most of these progenies in small trial plots at six years of age was not less than that of the control. Exceptions to this statement are N × P, P × Q, G × B and R × S, of which plot replicates were inadequate for assessment of yield; and J × K, where yield based on five replicates was significantly 50% greater than the control. This progeny is morphologically similar to the China variety, which ordinarily makes tea quite unacceptable by Assam standards. The mating thus raises the possibility of Assam tea from a notably hardy kind of plant. These seed-bearing clones have been multiplied as a bi-clonal bari (orchard) to provide seed for field trials elsewhere. Along other lines, breeding has not progressed far enough to justify a final choice of material.

The progeny L × M, with yield the same as the control, is quoted for the benefit of optimistic amateurs. It is

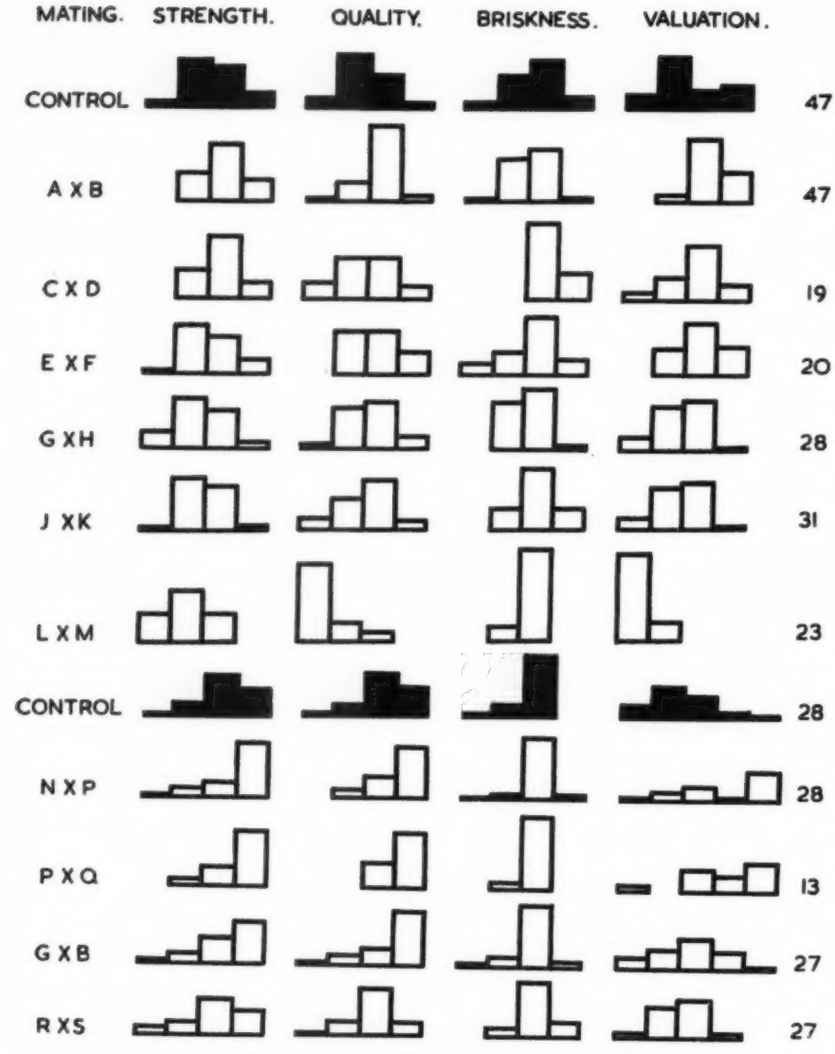


Fig. 10 (left). *Tasters' reports on* 10 *progenies. Column height gives relative frequency of poor, good, better, best, reports on strength, quality and briskness. Numerals on the right give the absolute number of reports on manufactures spread over the manufacturing season. The upper control is comparable with the first six progenies; the lower control with the last four progenies, in which a fifth category of values was attained sufficiently often to require separate record. Difference between controls is due to seasonal and block factors. Samples known to the taster only by numbers randomised on every occasion*

the result of mating two good-looking plants accepted entirely on tea estate standards.

Acknowledgments

The progress of the Association's tea-breeding programme has been largely due to the unremitting efforts of the author's assistants, Mr. P. K. Barua and Mr. T. R. Puzari, especially during the military occupation of the station 1941–46. We are indebted to the Director of Tocklai and the Indian Tea Association for permission to publish our results.

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Equipped with an Hydraulic Angledozer, this 'Challenger 3' Diesel Crawler Tractor (with Meadows 95-b.h.p. diesel engine) is shown clearing trees and hedgerows in order to make easier the cultivation of land in Brittany, France

Technical News

Corrosion Technology for July contains articles on 'Use of Plant Instruments in Corrosive Atmospheres' by Leo Walter and 'Control of Materials to Minimise Corrosion' by P. Mabb.

Articles included in the July issue of *Chemical and Process Engineering* are 'Fuel Efficiency in the Chemical and Allied Industries—Some Case Histories', 'Ore-Dressing Research in India' and 'Chemical and Engineering Progress at the Atomic Energy Research Establishment, Harwell'.

The July issue of *Building Materials* will include articles on 'Gypsum in Roofing—its Insulating and Fire-Resisting Qualities' and 'Pre-assembled Units of Fibreboard'.

The contents of *Muck Shifter* for July will include articles on 'Samarrah Barrage and Dyke, Iraq' and 'Open-pit Mining of Low-grade Iron Ore—Large-scale Earth-moving Equipment' by John Grindrod.

COST OF OPENING-UP TEA ESTATES

Expenditure in India, Ceylon and Africa

C. R. HARLER

During the course of the last 90 years the tea industry has been beset by no less than six slumps, but, however, these have not prevented planters opening up new estates. With an ever-expanding world market for tea and despite other setbacks the urge to extend is always prevalent.

TEA, like any other crop, must show a fair return in profits for the energy and outlay spent in its production. With many crops, when an excess causes prices to fall below the economic level, the acreage and output can soon be adjusted to equate supply with demand. With tea, however, the stand has a life of 40 years or more, so that any rapid change in area is impossible, and large acreages, together with an expensive factory and establishment, must be maintained, sometimes for two or three seasons, at a considerable loss during a slump in prices. It is true that when necessary the tea harvest can be restricted by plucking fine leaf, but this procedure is not as easy or as simple as might be expected. In any case, the reduced out-turn per acre which results from fine plucking affects revenue and reduces the benefit derived from higher sale prices.

These facts and hazards are only too well known to the tea plantation industry, which has had to cope with no less than six periods of slump, the first of which occurred in 1866, 90 years ago. Two of these difficult periods, 1896–1904 and 1929–33, extended over several years. In spite of repeated setbacks, the urge to extend is always active, fostered no doubt by an expanding world market for the beverage.

It is unlikely that in the near future large new areas will be planted in India, Ceylon or Indonesia, but planting in Eastern Africa is rapidly going ahead. For this reason notes on present-day costs in that area are of use and comparison with past and present costs in India and Ceylon is of interest.

The economic unit for a tea estate, with its own factory, is 500 to 1,000 acres planted. The harvest begins in the third year from seed and in this year some factory accommodation is necessary. A tea estate yielding 1,500 lb. of tea per acre needs two workers per acre (this includes those on services and in the factory), who must be housed and maintained even in slack periods. As will be shown below, the present cost of bringing an estate into bearing, including expenditure on factory, buildings and houses, is up to £400 per acre. It will be appreciated that tea-growing on plantation scale involves considerable initial outlay, much long-term planning and also connotes confidence in the future of the industry.

Tea under shade trees in Kencho, Kenya. Altitude about 6,000 ft.

The early days in Assam

Figures relating to opening costs in Assam are of more than academic interest. The tea-planting industry started in India in 1839 and by 1880 more than 200,000 acres had been planted to tea in Assam and Bengal. This area averaged about 300 lb. of tea per acre and produced a total annual out-turn of 60 million lb. At this period Ceylon had only just embarked on the tea venture and Java did not seriously begin production till about 1900.

In 1880 a man's daily wage was 4 annas (about 4½*d.*) and good tea land could be bought in North-East India for about 8 rupees (12*s.*) per acre. Seed was sown at stake, straight into the field, and nursery plants were only used for filling subsequent vacancies. It cost about 4 rupees (6*s.*) to pluck 320 lb. of leaf, which was withered to about 240 lb. and then hand-rolled by eight men, at a rate of 30 lb. of withered leaf per day per man. There was practically no machinery in use at this time. It took another man a whole day to dry the 240 lb. of rolled leaf over a charcoal fire, to produce an out-turn of about 80 lb. of dried tea.

This last was picked over and sorted in a day by one man and a couple of boys.

The tea house, as the factory was called, consisted of withering sheds and a thatched building, with long rolling tables and *chulas* or stoves for drying the tea. The cost of a tea house and equipment to deal with the out-turn of 500 acres of tea was about Rs. 15,000 (£1,140).

Much soil cultivation was done in the early days and up to Rs. 100 per acre might be spent in a year, which is several times the amount spent today. This is because it has been shown that soil stirring *per se* does not benefit the bush, but weeds do harm, and these can be controlled by growing a large bush which covers and shades the soil, thereby controlling weed growth.

In 1880 the expenditure over the first eight years in opening-up a 500-acre estate at the rate of 100 acres per annum, to build a tea house and quarters for staff and labour came to about £26,000. Today the cost would be perhaps £200,000, half of which is spent on good, brick buildings and a highly mechanised factory. The area planted today is capable of yielding about 1,500 lb. of fine tea per acre or five times that expected in 1880. Thus present costs do not compare so unfavourably with those of the early days as would appear at first sight.

The value of the rupee in terms of sterling has varied widely through the years, but for all calculations in the present discussion an exchange rate of *1s. 6d.* to the rupee is assumed.

Costs between the wars in Assam and Ceylon

About 1925 the tea industry was passing through a phase of prosperity and a considerable amount of opening-up was done in Assam, often with the aid of tractors and mechanical aids available at that time. It was then reckoned that the all-in cost to extend an estate was about £70 per acre, whereas to open-up a new estate, with a factory, main buildings and houses as well, cost about £130 per acre. Some estates in Upper Assam put out at this time ran to a much higher figure, approaching £200 per acre. At this period a good stand of tea was expected to yield 800 to 1,000 lb. per acre, for the industry at that time was not conscious of the possibilities of, and the benefits to be derived from, the selection of high-yielding plants, nor of the extent to which fertilisers could profitably be applied.

At this period in Ceylon it was calculated that in the high-grown areas, where tea may take eight years to mature, it would cost about £70 to bring an acre into bearing, of which about £45 per acre had to be added for factory, buildings and houses (total £120 per acre). In the mid-country, where tea matures in six years, the opening costs were about £65 per acre (total with factory £110 per acre). In the low-country, where tea comes into bearing in four years, a total outlay of about £95 per acre was expected. These costs were based on an average daily wage of 60 Ceylon cents (*11d.*) and bushes planted at 3,500 per acre. In Assam at this time bushes were usually planted at about 2,500 per acre.

The period 1927–33 witnessed a steady decline in the market price of tea, ending in a three-year slump. As a result, in 1933 the International Tea Regulation Scheme, to control exports and the planting of new tea areas, was inaugurated between India, Ceylon and the Netherlands East Indies. Then followed a period of steady sale prices from 1933 to 1939, during which time the opening-up of fresh lands was by agreement practically at a standstill. In North-East India, however, many unthrifty areas were uprooted and replanted, for about 300,000 acres of the stand was then well over 40 years old.

In Ceylon the tea is considerably younger than that in India and, in addition, the China-hybrid variety commonly planted there probably has a longer economic life than the Assam strains which are generally used in Assam, Bengal and South India. Accordingly, although the Ceylon estates were steadily infilled as vacancies occurred, extensive replanting was not undertaken in the years before the last war.

Plucking tea in Kenya

But now much of the Ceylon tea is due for replanting because many areas give yields which are uneconomic under conditions obtaining today. With this in mind some consideration of present costs is of interest.

Ceylon replanting costs today

At the eleventh biennial conference of the Tea Research Institute of Ceylon, held early in 1955, the question of replanting tea was fully discussed and later reported upon in the *Tea Quarterly*, 1955, **26** (March, June).

Ceylon tea is mainly planted on sloping land and therefore suffers from certain handicaps, the main one being soil erosion. Much of the stand is growing on what amounts to subsoil and before replanting can be a success soil renovation is desirable.

It is reckoned that it costs between 5,000 and 6,000 rupees per acre to rejuvenate and replant tea land in Ceylon today. Since the average out-turn of the present stand is only 600 to 700 lb. per acre, such expenditure would be uneconomic unless much higher yields can be anticipated. In fact, yields of about 1,200 lb. per acre are necessary. In order to achieve this, leaf cuttings taken from specially selected plants must be employed. Some of the clones in use at St. Coombs give 600 lb., 1,500 lb. and 2,000 lb. of tea per acre per annum over the first three-year pruning cycle. In the second cycle much higher returns are realised. These plants are good rooters, have high resistance to disease and generally give tea above the average quality. During the second cycle annual yields are above 2,000 lb. and some of the best clones reach 4,000 lb. The bushes are given heavy doses of fertiliser mixtures.

Turning now to the question of soil renovation in Ceylon, this involves a two-year fallow under Guatemala grass after the old tea is uprooted, followed by trenching and burying of the grass. Then the young clonal

plants, grown in the nursery, are put out in the field. They come into bearing in two years, making a total of four years, from the time of uprooting the previous stand. The cost of uprooting, soil rejuvenation extending over two years, and upkeep of the young tea for the next two years is shown in Table 1. The calculations are based on a gross average wage of Rs. 2/30 per day (3*s.* 6*d.*), uprooting is based on 5,000 bushes per acre and planting on 4,200.

The total sum amounts to about £400 per acre.

If a new estate were opened on virgin soil no soil rejuvenation would be necessary and the cost of clearing and planting would amount to Rs. 3,685 or £277 per acre. Added to this, to cater for a 500-acre estate yielding 2,000 lb. of tea per acre, expenditure of about 7½ lakhs (1 lakh = 100,000) of rupees for a factory and equipment would be necessary and about 5 lakhs for buildings, houses and roads (total 12½ lakhs or about £95,000). This would bring the total expenditure up to about £477 per acre.

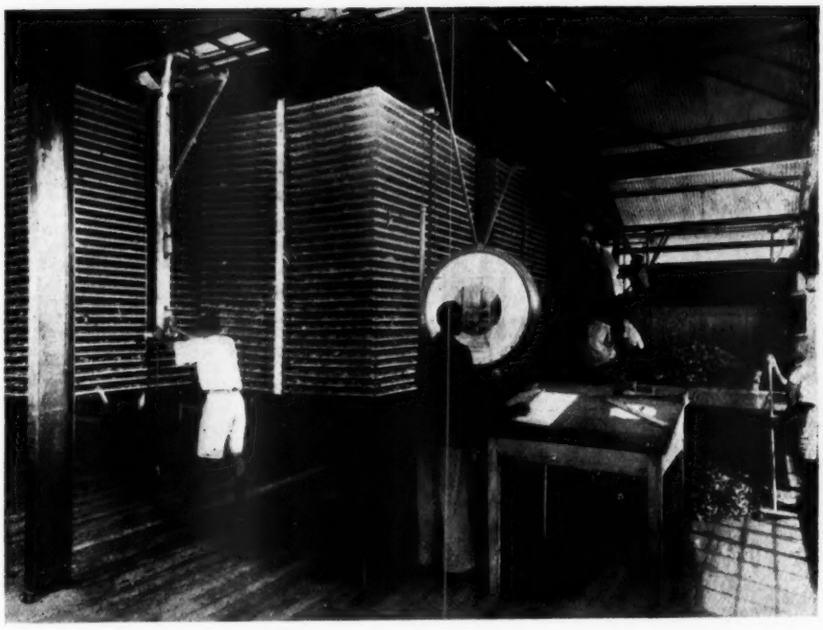
One speaker at the Ceylon conference mentioned at the beginning of this section, in dealing with the above figures remarked that there is a risk of highly priced Ceylon tea being replaced by tea mechanically plucked by others, say an Australian earning £20 a week as he mows the leaf off tea hedges planted in New Guinea.

This is a not unlikely development. Indeed, the planting of tea in northern Queensland is now under consideration, for climate, soil and lie of land there are suited to the crop. The only drawback is the cost of labour, but it is confidently thought that a country which has evolved competitive methods of producing rice, sugar and cotton by highly paid white workers can do the same with tea.

In India and Ceylon the bush is plucked every week or 10 days, making a total of 30 to 40 plucking rounds in the season, and only the ready shoots of two leaves and a bud are taken. More than half the labour on an estate is used for plucking. In Japan, where high labour costs were crippling the tea industry as long as 50 years ago, shears were then introduced for plucking the leaf and their use has been general since that time. The bushes are plucked three to five times a year only, and at each round the whole flush of five leaves and a bud is taken. With selected, high-yielding bushes, closely hedge-planted and heavily manured with mixtures giving up to 400 lb. nitrogen per acre, yields of 4,000 lb. of tea per acre are common. The average yield in Japan in 1942 was 1,500 lb. per acre, in spite of the fact that the stand there is of the extreme China type and the climate not as favourable as that in India or Ceylon, where less than half that average out-turn is realised.

TABLE 1

	Per acre
Cost of clearing land ..	Rs. 485
Soil rejuvenation ..	Rs. 1,585
Replanting tea	Rs. 3,200
Total ..	Rs. 5,260



Spreading the green leaf in the Limuru factory, Kenya. The operation is done at one central place in the factory, withering tats being tilted to allow for easy spreading. The banks of tats are then automatically weighed and wheeled into their respective positions in the factory. This modern method allows the tats being spaced more closely together and passage space between each of the tats is eliminated, thus giving a very much larger spreading area per withering loft and considerable saving in labour

Discrimination between fine and coarse leaf has not been made possible so far with mechanical plucking, and trials in the U.S.S.R. show that about 80% of the pluck may be good, whereas the rest consists of coarse leaf and twigs. But 20% of rough leaf does not ruin tea as a beverage.

Experiments with flush-plucking in Africa, where the whole flush of five leaves or so are machine-cut at one time, have shown that the Assam type of bush responds to this procedure, giving enormous crops of useful tea. Mechanical flush-plucking would certainly halve the labour force on a tea estate and greatly reduce costs.

Opening-up costs in Africa

It now remains to discuss the cost of planting-up tea land in Eastern Africa, where a thriving industry has been built up over the past 40 years, with areas in Kenya, Uganda, Tanganyika, the Belgian Congo, Nyasaland, Portuguese East Africa (Mozambique) and Southern Rhodesia. The tea stand now totals about 100,000 acres and annual production has reached 50 million lb. of tea.

The areas mentioned extend over a range of 1,500 miles from north to south, from the Equator in Kenya to 20° S latitude in Southern Rhodesia. The districts about the Equator and to 5° S are served by two rainy periods and these areas comprise what may be termed the Equatorial Tea Belt. The other tea lands, which include Southern Tanganyika, Nyasaland, Mozambique and Southern Rhodesia, form the Nyasa Tea Belt, and they have only one wet season lasting from about November to April, followed by a cool, dry period, then a hot, dry one. The climate and cropping rate resemble

those in Assam, although the rainfall is neither as plentiful nor as reliable as in North-East India.

The bringing up of tea in the Nyasa Tea Belt will now be described. The year starts in March–May, when the seed becomes available and nurseries are put out. Plants must be transferred to the field in December–January, in the early part of the wet season, which is the opposite from Assam procedure, where planting is best done at the beginning of the dry season. Stumps are taken from the nursery at about $1\frac{3}{4}$ years old and subsequent procedure is tabulated in Table 2, together with expected crops as the stand matures.

TABLE 2

Year	*Procedure*	*Yield of tea per acre, lb.*
1	March – May plant nursery	—
2	Plant in field Dec.–Jan.	—
3	Free growth in field	—
4	Cut 18 in. in June, pluck 30 in. ..	50
5	Unpruned	300
6	,, ...	500
7	Prune 20 in. in June	800
8	Unpruned	1,000
9	,, ...	1,200
10	,, ...	1,400

It will be seen that the annual increase in out-turn in Africa is markedly inferior to that expected from selected clonal plants in Ceylon. It is also poor compared with yields over the early years in Assam, where commercial seed is used. This defect in the Nyasa Tea Belt is due partly to the climate, which is difficult for young tea. However, apart from this, there is a great need for good, selected seed in Africa. Not only has selection in the seed gardens been lacking, but such has been the scarcity that seed taken from hybrid bushes in plucking has found ready sale.

It is general experience in Africa that when an estate of 500 acres, say, is planted in accordance with procedure outlined in Table 2, at the rate of 100 acres per annum, the revenue in the seventh year from the sale of the tea roughly balances recurrent expenditure in that year. From that time on profits are made on each season's working, provided a slump in sale prices is not in operation.

In opening-up a 500-acre estate it is reckoned that the following expenditure is involved in the first seven years:

Capital expenditure (factory, buildings, houses)	£100,000
Total recurrent expenditure ...	£100,000
Total	£200,000

The crop and the revenue from a 500-acre estate planted in annual lots of 100 acres may be calculated, reckoning the tea to sell at, say, 2*s.* 6*d.* per lb. (see Table 3). The average auction price of tea at present is about a shilling above that figure, but even then some Ceylon and Indian estates work at a loss.

TABLE 3

Year	*Tea made*	*Revenue at 30d. per lb.*
		£
1	Nil	—
2	Nil	—
3	Nil	—
4	100 acres, giving 50 lb. per acre: Total 5,000 lb.	625
5	As in year 4, plus 100 acres giving 300 lb. per acre: Total 35,000 lb.	4,375
6	As in year 5, plus 100 acres giving 500 lb. per acre: Total 85,000 lb.	10,625
7	As in year 6, plus 100 acres giving 800 lb. per acre: Total 165,000 lb. .. .. (In year 7 revenue should practically cover recurrent expenditure. Planting of the 500 acres is now complete).	20,625
8	As in year 7, plus 100 acres giving 1,000 lb. per acre: Total 265,000 lb.	33,125
9	As in year 8, less 5,000 lb. given in year 4 by the first planted tea, plus that same 100 acres now giving 1,200 lb. per acre: Total 380,000 lb. tea..	47,500

According to the calculations in Table 3, a 500-acre estate with eventual capacity rising to $\frac{3}{4}$ to 1 million lb. has been developed with capital outlay of certainly not more than £200,000, or £400 per acre.

Whatever the cost, tea development will go on somewhere in the world, and it appears likely that Eastern Africa will in the course of the next 20 years become one of the major producers.

Photos: Tea Bureau, London.

A new Caterpillar D7 Tractor pulling a John Deere-Killefer Ditcher, which is used in making ditches 30 in. deep, 40 in. wide and between 1,500 and 5,000 ft. in length. The tractor is owned by Hussein Bey El Ebesh, Hijane, Syria

Developments in Bulgarian Agriculture

I—Co-operative Farming in Bulgaria

DIMITER ZHELEV

We publish below, in two parts, an article concerning the great change that has taken place in Bulgarian agriculture since 1944. *Although the two notes cross at some points it was decided to publish them in their entirety in order to give as full a picture as possible. The information was obtained from official sources and tends to reflect the official Government view.*

ONLY a decade ago Bulgarian agriculture ranked among the most backward in Europe. The country numbered 1,100,000 farms, whose land was parcelled up in over 12 million plots; 14.4% of the farms (120,000 in number) had less than 2.5 acres of land each and possessed only 1.6% of the arable land. Over 165,000 small farms had no agricultural machinery and another 135,000 no draught animals. Crop yields were low. In the five prewar years (1934 to 1939) the average yield of wheat per acre never exceeded 520 kg. and rye and maize yielded 504 kg. per acre.

Such was the state of agriculture when the People's Government took over on 9 September, 1944. The country's new course of development demanded that this age-long backwardness be done away with as soon as possible. That is why, parallel with the country's industrialisation, a rapid process of reconstruction along socialist lines took place in the countryside.

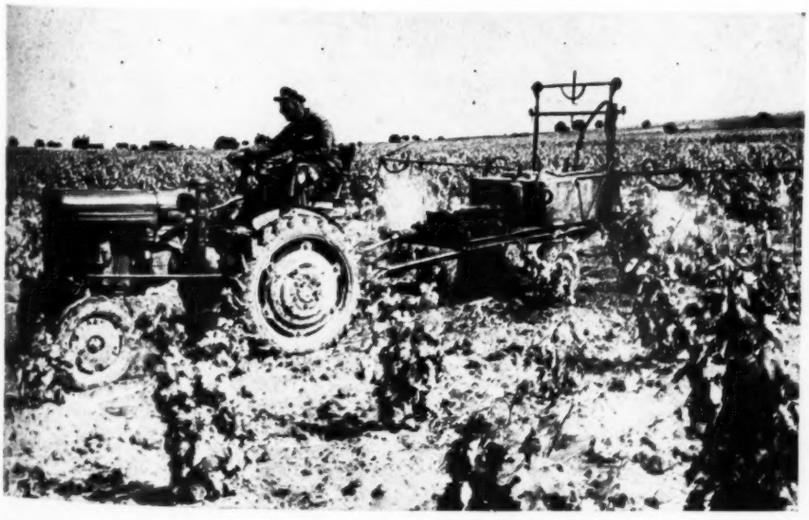
Voluntary collaboration

The method of this reconstruction, *i.e.* voluntary collaboration of the poor and medium peasants in the co-operative farms, was mapped out by the Bulgarian Communist Party. This new form of large-scale agricultural production proved most convenient for conditions in Bulgaria, since it is the easiest way to surmount the attachment of our peasants to their private plots and lead them along the new track of socialism.

The formation of co-operative farms in Bulgaria was launched immediately after the liberation from Fascism. By the end of 1945 the country already numbered 110 co-operative farms.

The first co-operative farms were organised as branches of the universal co-operative (consumer and purchasing) and as independent producer co-operatives outside its network.

From the very beginning the co-operative farms showed their advantages over the small-scale private farms, as a result of which the poor and medium peasants joined them in increasing numbers. The year 1950 marked a turning point in the development of the co-operative farms. In that year the medium peasants joined the latter *en masse*. By the end of the first five-year plan 2,747 co-operative farms had been organised, comprised of over 60% of her arable land and over half of the village households. The main grain-producing regions have almost completely been 'co-operated'.



Spraying an insecticidal formulation in a vineyard with an OKS sprinkler and adaptor

Mechanisation

The mechanisation of the basic processes of field work has also been considerably increased. In 1954, 69% of the pre-sowing ploughing was done by machine, as well as 50% of the sowing and 75% of the deep ploughing. Combine harvesters brought in 35.4% of the crop.

The work done by the machine and tractor stations in 1955 is nearly 10 times more than in 1948. A number of targets set in the second five-year plan (1953–57) for the mechanisation of agriculture were topped last year, *i.e.* in the third year of the same plan. The mechanisation of deep ploughing, for instance, was to reach 75% in 1957, whereas in fact it had already reached

76.5% of the total arable land last year; instead of 60% mechanised presowing ploughing at the end of the five-year plan, the percentage was 78.3.

Practically all co-operative farms have built cowsheds, piggeries, sheep pens and fowl houses and the majority of farms have stables too. The development of public stock-breeding has made it possible to mechanise a number of labour-consuming processes in the stock-breeding farms, such as watering, milking, haulage of fodder and manure and so on.

The constant growth of public property on the co-operative farms and the ceaseless increase of the yields multiply the incomes of the farms and farmers. Dozens of co-operative farms obtained yearly cash incomes from 3 to 5 million *leva* (£158,000–£274,000) and their members are prosperous people. The co-operators of the village of Krushare, Sliven County, for example, received 19.30 *leva* in cash for each workday in 1954, in addition to 1.970 kg. of wheat, 0.500 kg. of potatoes and many other products per workday. One family, which put in 1,200 workdays, got 23,160 leva, 2,364 kg. of wheat and rye, 28 kg. of wool, 72 kg. of cheese, 44 kg. of vegetable oil and 600 kg. of potatoes.

Soviet system

Bulgarian co-operative farms are large public agricultural establishments. They have much in common with the agricultural cartels in the Soviet Union—public means of production, State means of production (machine and tractor stations and others), public labour of the members, application of the socialist principle in distributing the income, in organising labour and in payment, allowing the co-operators to have additional private plots. However, there are a number of essential differences between the kolkhozes and the co-operative farms. In the latter the co-operators retain their private ownership of the land. In addition to the socialist principle in distributing the income, for the land they have contributed the co-operators obtain a rent apart from their labour remuneration.

The co-operative farm is therefore an original form of nascent socialist enterprise with vestiges of private ownership, mainly land, which will gradually merge into co-operative ownership. This is evident in the recent development of the co-operative farms. The socialist basis of the co-operative farms grows parallel with the relative increase in remuneration for the labour of co-operators, whereas the importance of the private land on a co-operative farm increasingly goes down with the successive reduction of the rent, which reduction is decided by the co-operators themselves when two-thirds of all members of the farm agree to it.

The Second National Co-operative Farm Conference held in 1950 decided that the maximum rent should not exceed 30% of the farm's total income which is to be distributed among its members. The Third National Co-operative Farm Conference held late in 1953 reduced this to 25%. On many co-operative farms the rent is 10, 15 to 20%, and on a number of farms the members have decided to eliminate the rent altogether. (This can only be done when absolutely all co-operators agree to it.)

Management

The supreme organ and only full master of the co-operative farm is the general meeting. It elects a board of five to nine managers to run the farm in the intervals between its meetings over a period of two years and a control council to check the entire activity of the board of managers in matters of production and finances.

The board of managers organises the farm's members in permanent work teams which are approved by the general meeting. The field work and garden teams are set up for a term no smaller than a complete rotation of crops and the orchard and vineyard teams for a term no smaller than five to six years. Each team is given a definite portion of land, the necessary machines, draught animals and buildings. The stock-breeding teams are set up for at least two years. They are given farm animals, the necessary equipment, hauling means and buildings. Each team consists of several groups. In 1954 the teams were enlarged to 100 to 120 members and were given additional land, so as to make wider use of the farm machines.

Harvesting cotton with a combine on a co-operative farm near the village of Resen

The Model Statute is the basic law of work on the co-operative farms. It embodies the socialist principle of combining the private interests of the co-operators with the public, State interests. It aims at a constant growth and consolidation of the farm's public property as the source of increasing benefit to the co-operators.

A co-operative farm's income in cash and kind is distributed in compliance with the Model Statute. In the first place the farm allocates part of its incomes in cash and kind for public measures, for the establishment of an indivisible fund, a fund for 'Assisting Disabled Co-operators', a fund for cultural needs, seeds, fodder, bad harvests and other calamities.

The remaining 90% of the co-operative farm incomes are distributed according to the quality of work done by the members and the land they have contributed for public usage. Under the Model Statute at least 75% of the farm's net income goes to pay the work done by its members, measured in workdays, and up to 25% of the rent for the land they have contributed. The distribution of the income among the co-operators is therefore based primarily on the amount of labour they put into production.

Insecticidal spraying in the Tolbukhin Forest

Consolidation

The People's Government and the Bulgarian Communist Party are ceaselessly concerned with consolidating the co-operative farms, with increasing agricultural production and raising the peasants' living standard.

An eloquent example of this concern is the increased State capital investments in agriculture during the second five-year period, which is 2.3 times above the level of the first five-year period, and the Decree of the Central Committee of the Bulgarian Communist Party of 21 January, 1955, for a further drive for higher yields in agriculture.

The increased State purchase prices of most agricultural products and the reduced payments in cash and kind to the machine and tractor stations for work done on the co-operative farms, the adoption of a more expedient system of advances to the co-operators throughout the year, as well as the transfer of a large number of skilled workers who are closely associated with the people of the countryside, will push our agriculture further ahead and consolidate our co-operative farms.

II—Character of Co-operative Farms

SVETOSLAV DONCHEV

THE rapid development of industry in Bulgaria required profound changes in the field of agriculture. Socialism could not be built on two differing bases, on the basis of a large-scale socialist industry and on the basis of a parcelled-up, backward, unprofitable agriculture producing a small amount of goods for the market. With the support of the working peasants the People's Government directed its attention to the co-operation of farming.

As a result of the decisions of the Central Committee of the Bulgarian Communist Party on 31 January, 1955, and of certain decisions of the Government, new material incentives were created for the peasant farmers, which, last year, led to an increase of output in important branches of agriculture and to a raising of the incomes of co-operative farmers.

The results so far in the sphere of the Socialist reconstruction of agriculture have convincingly shown the advantages of the co-operative system This has led to a new upswing of the co-operative movement in the country. In only a few months, from the beginning of this year up till now, a further 282,000 households with over 2 million acres have been admitted to co-operative farms. Almost 77% of households and over 75% of the land are already in co-operatives. This creates the necessary conditions with strict observance of the principle of voluntariness for the final completion

of the Socialist reconstruction of our rural economy in the near future.

Land cultivation was considerably improved by the application of agro-technics. Large co-operative stock-breeding farms were set up where the breeding of farm animals is constantly improved, new breeds are created and the productivity of stock-breeding is constantly raised.

Farm branches

The co-operative system has come to stay in the Bulgarian countryside. The co-operative farms are developing an ever larger number of farm branches. The areas under industrial crops—vineyards, rice and tobacco fields, orchards and market gardens—were considerably extended. A number of entirely new intensive crops are already being grown in this country.

The yields now obtained in agriculture were unknown in capitalist Bulgaria. In the best years prior to 9 September, 1944, the average wheat yield, for instance, never exceeded 520 kg. per acre. A large number of co-operative farms now obtain average yields of over a ton per acre. The yields of all agricultural crops have been raised.

The newly built dams and irrigation systems greatly contributed to the increase in the yields of the Bulgarian land. The irrigated areas expanded from 93,750 acres in 1944 to 675,000 acres in 1954. This year the irrigated areas in Bulgaria will be increased by an additional 100,000 acres. By the end of the second five-year plan the irrigated area will reach 1,250,000 acres. The high mechanisation of agriculture also contributes to the increase in yields.

Instead of the 3,500 tractors of the most varied kind and type used up to 9 September, 1944, mainly as tractors for threshers, at the end of 1955 the country disposed of over 18,200 tractors (in 15-h.p. units), over 3,150 combine harvesters (machines unknown in the Bulgarian countryside up to 1950), 6,000 threshers, 11,600 tractor ploughs and over 36,000 other farm machines. Under the 1956 plan 15.6% of the gross capital investments are allocated to agriculture. Of these funds, 51.4% will be spent on mechanisation, 41.5% on new farm buildings, irrigation systems and surveying, and 6% on increasing the number of productive animals on the State farms and in the research institutes. Obviously, the major part of the capital investments is to be used to consolidate the material and technical basis of agriculture. This year our farms are to be supplied with another 2,740 tractors, 1,370 combine harvesters and 7,800 trailers—ploughs, seed drills, cultivators and other machines.

Besides the large sums allocated to capital investments in agriculture in the State budget, new funds will also pour in this year as a result of the new economic agreement between the Soviet Union and Bulgaria.

By virtue of this agreement the Soviet Union will grant Bulgaria a loan consisting of tractors, combine harvesters, excavators, windrowers and other farm machines, as well as pedigree livestock, to the value of 300 million roubles. Bulgaria will also receive technical aid in building a nitrogen-fertiliser plant, which will produce 200 to 220 thousand tons of silicate of ammonia a year, and a phosphate-fertiliser plant whose initial production capacity of 100 thousand tons will in time be extended to 200 thousand tons. To enable Bulgaria to pay for the equipment, design work and other kinds of technical aid in building these plants, the Soviet Union will grant her a loan of 70 million roubles.

The new economic agreement, which covers a period of three years, opens up bright prospects for the development of agriculture in this country. The Soviet machines will decisively raise the level of mechanisation in farm work. With the delivery of the new machines mechanisation on the co-operative farms will be doubled. The economic effect of the 300 thousand tons of mineral fertilisers will amount, in the present conditions, to more than 700 thousand tons of grain, tens of thousands of tons of cotton, first-grade tobacco, grapes, apples, vegetables and other valuable products.

The agreement also envisages a supply of thousands of highly productive pedigree livestock—cows and merino sheep to the value of over 7 million roubles.

The marked rise in mechanisation and the general improvement of agriculture and stock-breeding will undoubtedly lead to an increase in agricultural output; the incomes of the working peasants will consequently go up and the co-operative movement in the countryside will be given a new impetus.

Changing countryside

What was impossible for small-scale agriculture was easily achieved in large-scale co-operative farming. There is a Bulgarian proverb which says: 'A united group can move mountains'. By work in common the co-operators have changed the aspect of the Bulgarian countryside. Moreover, the co-operative farms have done away with the lack of land and hidden unemployment in agriculture. The arable land in Bulgaria has been considerably extended and continues to extend through the irrigation of droughty regions and the draining of swamps, where works became possible only on the basis of collective labour. Sprayed with artificial fertilisers made in Bulgaria and tilled by machines the Bulgarian land yields ever richer fruit. Nobody speaks of lack of land in Bulgaria now because that means shortage of land with respect to manpower; it means a superfluity of labour. Large-scale construction is in progress in the country and it requires even greater manpower. This construction has necessitated the influx of working peasants into the towns; this has done away with the hidden unemployment in the Bulgarian countryside.

Character of co-operative farms

What is the essence, the character of the co-operative farms in Bulgaria as a form of large-scale agricultural enterprise?

The land in the co-operative farms is merged in tracts, but it does not belong to the co-operative; it has remained the property of the individual peasant. This does not, however, mean that the capitalist principles of organising production have been retained and are operating on the co-operative farms. The land is for the public use of the collective, not for the private use of the individual farmer. The machines—one of the basic and decisive means of production on the co-operative farm—are national property. They are placed at the farms' disposal by the State through the machine and tractor

(*Continued on page* 284)

Atomic Energy's Contribution to Agriculture

Dr. PAUL B. PEARSON

(*Chief of the Biology Branch, U.S. Atomic Energy Commission*)

Speaking at Lincoln, Nebraska, U.S.A., late last year, Dr. Pearson gave a summary of atomic energy's contribution to agriculture, which we publish below. Agricultural research, utilising atomic methods, is proceeding over most parts of the earth. At the National Institute of Agricultural Science, Tokyo, for instance, soil samples are being treated with radioactive sulphur and iron compounds to determine how sulphur from fertilisers and organic matter in the soil is causing damage to crops and how iron in the soil prevents such damage. The Japanese are also making extensive research with radioactive tracers in fertiliser experiments.

ATOMIC energy as an industry and its applications to agriculture are still in their infancy—as it is only a decade since energy was first mass produced by nuclear fission. Progress in the application and utilisation of atomic energy for the benefit of mankind has, I believe, moved forward far more rapidly than any previous major discovery. Could we gaze into a crystal ball it is likely that we would see advances and developments that few of us even dream of today.

While I do not foresee that radioisotopes will be used directly by farmers, it does not follow that they may not play a major role in the solution of agricultural problems, or that they may not change the pattern of agricultural practices in this as well as other countries.

The microscope in the hands of Pasteur saved the wine industry of France, the cattle industry from anthrax, and through each succeeding decade one could point out contributions to agriculture that have come through the microscope in the hands of the scientists.

It may well be that radioisotopes as a new research tool will rank with or even exceed the microscope in its contributions to the development of agriculture. In the short span of 10 years radioisotopes have become almost a byword to scientists. It is doubtful that today one could find an agricultural experiment station in the U.S.A. where they are not used as a research tool.

By American standards, probably not more than one-third of the world's population is adequately fed and clothed. How long can we hope to maintain even our present standards with the current rate of increase in population? From the time of the birth of Christ until about A.D. 1600 the number of people on the earth just about doubled, whereas during the last 100 years the population doubled to about 2,400 millions. This is a startling rate of population growth and comes home more forcefully if you stop to think that as one sits down to dinner tonight there will be 35,000 more persons at the world's dinner table than there were this morning for breakfast.

In the U.S.A. each person uses about 3,000 calories as food daily, and about 40 times this amount, or 125,000 calories per day, for heat and power. For the world as a whole, the figures are much lower, averaging about 2,400 calories per day for food and 6,000 calories for heat and power.

A hope and a challenge

In some of the energy-poor countries as much as 80% of the energy may come from the burning of dung, which could much better be used for increasing the agricultural production. Can atomic energy meet the needs of the growing population for energy? Can the standards of living, health and education be improved and tensions thereby relieved by the peaceful uses of atomic energy? This is a hope and a challenge to each of us today.

When economic power from nuclear reactors becomes generally available, this new energy source undoubtedly will make a substantial impact on society. It should favour industrialisation and help to increase the standard of living, especially in those countries where other sources of energy, such as coal, oil and hydroelectric power, are expensive or unavailable. In such areas nuclear power may well cheapen production and distribution costs of food.

Other possibilities

The prospects of economic nuclear power offer various other possibilities. For example, nuclear power may one day be used to provide large quantities of fresh water from the sea at a reasonable cost for some of the arid and waterless areas near the sea. This could increase agricultural production in some areas, industrialisation and shifts in the centres of population. In many of the irrigated sections of our country the underground supply of water is gradually being reduced. Isotopes provide a new tool for studying the age of water and rates of replenishment. Some waters now being used for irrigation have been found to be over 100 years old.

Value of radioisotopes

The more immediate and chief contributions of radioisotopes and atomic energy are indirect, but nevertheless of immense potential value. The value of radioisotopes arises from the ease and great accuracy with which they can be identified and measured, which makes it possible to use them as highly refined research tools in a wide variety of biological and agricultural problems with plants, animals and man.

Ionising radiations, irrespective of the mode of production and of properties, can induce genetic changes which are stable and lead to new traits manifested in succeeding generations. These induced genetic changes are essentially the same as in spontaneous mutations. Nevertheless, recent work in several countries, particularly Sweden and the U.S.A., has shown that the induction of mutations by radiation is an important tool in plant breeding.

By irradiating oat seeds a strain of oats has been developed that is resistant to one of the most damaging rusts in the mid-west. In Sweden the most widely grown variety of white mustard was developed by radiation. This new variety yields about 7% more grain with a higher oil content than the original strain.

There are many other cases of improved strains of various crops that have been produced by radiation.

By using radioisotopes, the soil scientists can find out for the first time what proportion of various nutrients the plant derives from the soil and what proportion is taken up from the applied fertiliser.

It is estimated that if the tobacco farmers of the state of North Carolina make use of the information gained by the researchers using radioisotopes that there would be an annual saving of over 100,000 lb. of phosphate. This figure could, of course, be multiplied many times with other crops and in other States. This saving is very important, since there is not sufficient phosphate fertiliser to meet present agricultural needs.

It is commonly thought that roots are the principal organs through which plants absorb nutrients. These are then transported to other portions of the plant, as stems, leaves, flowers and fruits.

Recently, by using radioisotopes, it has been found that the foliage and leaves of plants can be important pathways for the entry of nutrients into plants. The surface area of the above-ground portions of trees and plants may be several times greater than that for the roots. It is estimated that the leaf surface of a 12-year-old apple tree may be equal to about the area of ¼ acre. By isotopic techniques, the highly mobile elements of nitrogen, phosphorus, potassium and rubidium applied to the leaves have been shown to be freely absorbed and transported in both an up and down direction in the plant.

On the other hand, calcium, strontium and barium are poorly absorbed and move very slowly in the plant, indicating that foliar application of these nutrients is not effective.

The use of radioactive isotopes for research in ion movement or transport by plants is twofold. They serve as superior analytical tools, extending the sensitivity and specificity and increasing the ease of analysis beyond what can be achieved by conventional analytical methods.

Radioactive isotopes have vastly accelerated research into the mineral nutrition of plants and have made possible an understanding of the dynamics of biological ion transport that would be inconceivable without them. Specifically, studies on ion transport in the roots of higher plants have shown that ions freely move into and out of the ' outer ' space of the roots, by diffusion and exchange, independent of the simultaneous active transport into an inner space where they are no longer exchangeable with the same or other ionic species.

The process of photosynthesis or the mechanism whereby plants in the presence of sunlight utilise carbon dioxide and water, and form sugar, starches and fats, and then with nitrogen form the essential building blocks of some 13 amino-acids as proteins is probably the most important biological process on earth. Without photosynthesis there would be no forms of life on the earth as we know them today.

There is an abundant supply of solar energy, of which man utilises only a small percentage. The use of radiocarbon-14 makes it possible to study the complex pathways of biosynthesis. Plants grown in an atmosphere containing carbon-14 in the carbon dioxide will utilise the labelled carbon in forming foodstuffs. It has been possible to show that among the first

Extensive atomic research to develop better strains of plant foods has been performed in a large field at Brookhaven National Laboratory, Long Island, New York. In the centre of the field is a 7-ft. iron pipe containing radioactive cobalt, and planted around it in large circles are crops of many varieties. γ-rays issuing from the pipe cause changes in the plant cells, or mutations. Some improved strains of plants have been developed and more are expected as research continues

products formed are 5- and 7-carbon sugars.

The complexity of the system is apparent in the fact that in a few seconds a plant will fix carbon dioxide in the form of 10 or more compounds in quantities that can be isolated and identified. Radiocarbon makes it possible to distinguish between those compounds that are present before exposure to the radioactive atmosphere and those formed during the experiment.

Scientists have gone a long way towards unravelling this mystery of nature. It is quite within the realm of possibility that the time will come when man does not have to depend on plants to produce edible energy in the form of starches, sugars, fats and proteins, and we may see this done chemically on a commercial scale.

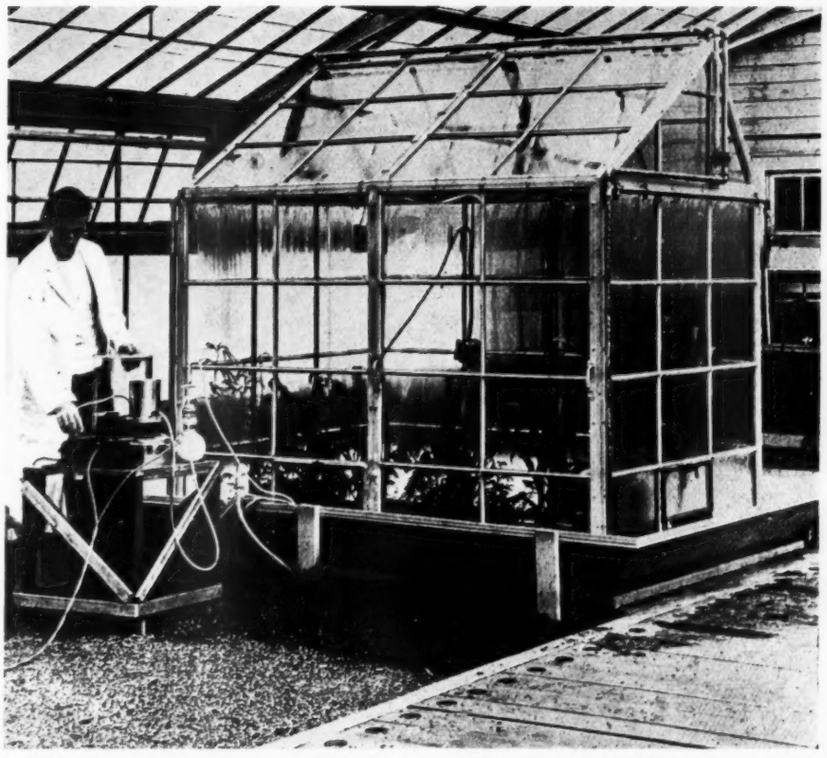
Fighting the screw-worm

Such are the secrets of nature that will be answered by the atom and they most certainly will presage changes in farming and agricultural practices.

Entomologists have successfully eradicated screw-worms from a limited area in one of the Caribbean islands. Male flies were made sterile by radiation and then dropped from planes to mate with the native female flies. Since the female mates only once no offspring are produced if she mates with an irradiated sterile male.

Insect pests are responsible for large annual losses in both crops and livestock. Successful attack by chemical means requires knowledge of the habits and life cycle of the insect, as well as information on its physiology and metabolism. Insects may be tagged with cobalt-60, for example, and their flight range, migration and overwintering habits determined. More accurate estimates of the population of an insect species can also be made by this method.

Tagging the insecticide permits evaluation of the efficiency of the method of application, study of its mode of uptake, and metabolism by the insect. Such information makes a definite contribution to the development of more effective agents and methods of use. How insects develop resistance to specific insecticides, such as DDT, is being investigated by tagging the compound with radiocarbon. The radioisotope makes it possible to compare the uptake and metabolism of DDT by strains of susceptible and resistant flies.



Important studies on photosynthesis are being undertaken in this small hot-house garden at the U.S. Atomic Energy Commission's Argonne National Laboratory near Chicago. Plants grown in this chamber are supplied with measured amounts of water, nutrient materials and radioactive carbon dioxide. By this method the scientists are attempting to determine how the plants use carbon and oxygen in their growth processes

Systemic insecticides and pesticides (compounds that are absorbed by the plant or animal and destroy the insect feeding thereon) promise significant gains in the continuing war on plant and animal pests, but basic information on the uptake, translocation and metabolism of these compounds by the host plant or animal is essential. Radioactive-tracer techniques are indispensable in obtaining this information.

Growth regulation

Crop production may be significantly increased in the future by growth-regulating compounds because of their ability to advance or retard crop maturity or through chemical weed control. Here again it is of manifest importance to have fundamental knowledge of the absorption and translocation mechanisms involved in the crop plant.

Tagging the compounds of interest with radiocarbon or radioiodine makes it possible to follow their absorption and translocation and to measure the total uptake, even though the amounts involved are as small as one-millionth of a gramme.

It is also essential to know that the compounds used on edible crops are not changed after application into products detrimental to animals or man. Tagging the compound makes it possible to identify any such metabolic products. For example, by tagging 2,4-D it has been shown that bean plants readily absorb the herbicide and that the compound is distributed throughout the plant together with at least two additional products derived from it.

Maintenance of soil fertility and crop yields is of prime importance, and soil scientists and agronomists have found in the use of radioactive tracers a tool that opens new avenues of attack on problems of soil–fertiliser–plant relationships. The tool is used in basic research to determine the factors affecting nutrient absorption and translocation by plants or the mechanism of fixation and release by the soil of

important nutrients, such as phosphorus or calcium.

Radioisotopes of most of the elements important in plant nutrition enable the investigators to follow the movement of these elements in minute quantities from the nutrient solution throughout the plant and to study the mechanisms involved in uptake and metabolism.

Radioisotopes are playing an important role in fundamental research in animal metabolism which, in years to come, will undoubtedly contribute to increased production through better, more economical feeds and management practices. Until radioactive forms of elements—phosphorus, calcium and sulphur, for example—became available it was possible only to speculate on the processes involved in the metabolism of such elements from the feed consumed to the animal product.

Studies on milk formation provide a good example of the effectiveness of the new ' tracer technique ' procedure. Carbon-14 is used to label diet components. Subsequent examination of the milk, tissue and body fluids for radioactivity shows whether or not the labelled components contribute directly to milk production and often indicates the metabolic pathways involved.

Comparison of results obtained with the whole animal and with the isolated udder makes it possible to differentiate those diet components that may be directly utilised by the udder in the formation of milk constituents from those that require modification by microbial action in the rumen or other metabolic action in the body before becoming milk components.

Radioactive tracers

The use of inorganic sulphate tagged with radiosulphur has shown that non-ruminants are capable of synthesising at least part of the required essential amino-acid cystine from this source. This indicates the possibility of reducing feed costs by substituting an inexpensive inorganic material for a part, at least, of the more costly source.

Before radioactive tracers became available the value of a nutrient source, for animals, was established by comparing the amount of a selected dietary component in the feed and in the excreta, a procedure which was often misleading.

For example, on the basis of this procedure, alfalfa was considered to be a poor source of phosphorus for lambs, only about 20% of the element apparently being absorbed. Using alfalfa tagged with the radiophosphorus, research has shown that actually about 90% of the alfalfa phosphorus is utilised by the lamb.

The low figure from the earlier method was due to the rapid turnover of the phosphorus in the growing lamb. Thus, a high percentage of the phosphorus in the excreta is body phosphorus, that is, it has been absorbed earlier, used in metabolic reactions and returned to the gut.

Radio-iodine is being used as a tool to develop strains of cattle that are high milk producers and concurrently have a high tolerance for heat. European breeds of cattle which are most common in the U.S.A. have a low heat tolerance compared to Indian breeds. Also the thyroid-gland activity of the Indian and European breeds differs. Iodine-131 can be used as a quick measure for desired characteristics of the Indian breeds; these then can be introduced into European breeds by cross-breeding and selection.

Plant diseases

Radioisotopes are being used in a variety of ways to study plant diseases. Canadian forests are suffering from a die-back in birch, and in the mid-west the stand of oak trees is being threatened by a virus disease called ' oak wilt '. Radioactive phosphorus and rubidium have been used in the study of the die-back in birch.

Studies with these isotopes have shown that the normal narrow-band upward spiral path of solution movement is broken in the diseased tree and replaced near the dying region by a confused irregular pattern of fibre which the nutrients do not pass through.

In the ' oak wilt ' disease evidence has been obtained using radiophosphorus, showing that the virus passes from a diseased tree to an adjacent healthy tree through anastomosed root systems. Although no control for these diseases has been found, it may be anticipated that radioisotopes will play their part in the ultimate solution.

The many and diverse ways that radioisotopes are being used for the solution of agricultural problems read like a fairy tale.

Today atomic energy provides a new dawn of hope for mankind. It emphasises in a dramatic way the universality and unity of all fields of science. If we can meet the challenge in utilising atomic energy for peaceful uses, it may well be the means of providing for all peoples a higher standard of living, better health and relaxation of world tensions.

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Photos: U.S. Information Service

IH Change

The Industrial Power Division of the International Harvester Co., Chicago, Ill., U.S.A., is now known as the Construction Equipment Division, according to an announcement by Harald T. Reishus, vice-president of that division.

Trash Disposal

The disposal of waste vegetable matter after cropping and the clearing of weed-infested ground can often be a real problem, especially on farms where there is a shortage of labour or where the work has to be done quickly and economically to prepare ground ready for the plough.

The Wilder-Rainthorpe multi-purpose chopper (John Wilder Ltd., Wallingford, Berks, England) is a new implement, which has been designed to help farmers, contractors and landowners. It provides a quick and easy means for disposal of straw after combining, vegetable waste after cropping and for clearing land of scrub, gorse, bracken, rushes or other growths. In fact, the machine can be put to a wide variety of uses and can be kept busy throughout the year.

Use in tropical agriculture

Tests are about to commence in South Africa on the use of this machine for disposal of sugar-cane trash. It is felt that this machine will find a good market in tropical countries where there is a need for a machine which will chop up crops and leave them finely chopped on the ground as a surface mulch which will retain moisture in the soil and which, because it is chopped, can be eventually turned into the ground as humus.

Wheat and Barley Production in Cyprus

J. PARISINOS, B.SC.

(*Agricultural Officer, Department of Agriculture, Cyprus*)

Possessing a typically Mediterranean type of climate and generally poor soil, the island of Cyprus has for many years struggled to increase yields of her two most important crops, wheat and barley. Her agricultural economy rests mainly on these two crops. In the present improvement programme the obtaining of varieties from countries with a more or less similar climate, breeding projects and seed production have been emphasised.

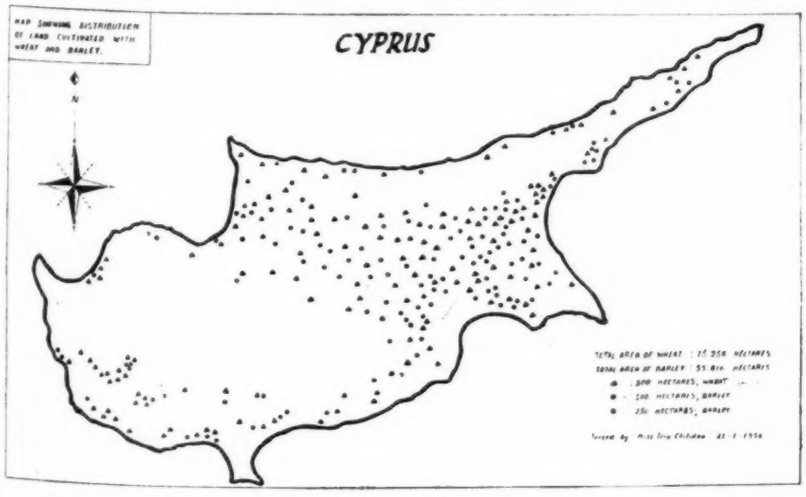
WHEAT and barley are the two most important crops in the agricultural economy of Cyprus, a country where farming is the economic backbone and the main occupation of its people.

Cyprus lies on the 35th parallel in the eastern basin of the Mediterranean Sea. The total area of the island amounts to approximately 933,960 ha. About half this area is privately owned agricultural land. The greater part of the arable land is situated in a central plain (Messaoria), which extends through the middle of the island from the west to the east coast, rising to an altitude of 150 m. near the centre, where the capital, Nicosia, is situated. To the north the plain is bounded by the Northern Range of mountains, which rise to 915 m. in places. To the south and south-west the Southern Range, a more extensive and massive range, rises to some 1,950 m. Between both ranges of mountains and the sea there is a narrow littoral.

Cyprus possesses a typically Mediterranean type of climate, characterised by winter rainfall and marked summer drought. Winters are usually mild and summers are hot as well as dry. Considerable local differences in the amount of annual rainfall exist among stations on the island. The distribution of rainfall during the rainy season, as well as over the years, also varies quite considerably. The rainfall does not only fall during a short period of the year, but it is generally heavy and occurs on few days and in few hours on those days. Annual rainfall figures vary from about 300 mm. in the plains to over 900 mm. at the higher elevations.

The soils of Cyprus are generally poor and highly deficient in phosphates and nitrates, a result, no doubt, of continuous cultivation for perhaps thousands of years. They are, on the whole, rich in lime.

Cereal cultivation is mainly practised in small and subdivided holdings in the central and coastal plains, although scattered patches of both wheat and barley may be encountered in the hills up to an altitude of 600 to 900 m. Inter-cropping with cereals on land on which scattered olive and carob trees grow is not uncommon, particularly in the coastal districts.



Cereal culture in Cyprus is undoubtedly extremely ancient. According to certain reports, much grain was exported in bygone days to the neighbouring countries. Nowadays, however, with the increase in population, the local production is insufficient. In normal years 50% of the island's requirements of bread wheat has to be imported from overseas. On the other hand, a quantity of barley amounting on the average to about 10% of the total yearly production is exported.

Production

From the production records of the last 50 years it can be observed that the area under wheat and barley remained remarkably constant, but wide fluctuations in the yields of these two crops, especially of wheat, can be discerned. This irregularity in production must be attributed to climatic factors and to incidence, at times, of disease epidemics.

In Table 1 are presented data on yields, areas and total production for the crop years 1951–52 to 1953–54.

Under present-day conditions much cereal cultivation in this country is on the margin of economic production. Although heavily subsidised by the Government, wheat and barley cultivation probably leaves but little profit to

many growers. This can be partly attributed to the high costs of production accentuated by an extreme degree of fragmentation of holdings, which prevents profitable utilisation of farm machinery, and partly to climatic and other environmental factors. The season suitable for rapid vegetative growth is on the average short and the rainfall during this time is erratic. As a result, yields fluctuate considerably from year to year and very often are below the level of economic production.

Varieties cultivated

Wheat.—Except for the new varieties bred by the Department of Agriculture, the origin of the wheats which are at present under cultivation in Cyprus is not known. Some types appear to be of comparatively recent introduction from neighbouring countries. Others are very old forms indigenous to the island.

The wheats grown in Cyprus belong almost exclusively to the *Triticum durum* species; the reason for this is not well understood. Certain opinions suggest that probably it is due to the drought and disease resistance possessed by this species, which enabled it to survive through the long ages. According to Flaksberger, however, Cyprus is situated on the border of the area of origin for the *T. durum*. Wheats, apparently durums, have been cultivated on the island since time immemorial. Flaksberger arrived at this conclusion following the discovery in Cyprus of liguleless durum wheats, which he regarded as ' biologically primitive forms preserved in the centre of origin since the time of an increased arising of forms '.

As a whole, the varieties of wheat grown locally are early-maturing types attuned to a short growing season. They appear to possess marked drought-resisting qualities. They grow tall, particularly under fertile soil conditions when adequate moisture supply is available. Consequently, they suffer from the disadvantage of being very susceptible to lodging.

The grain, as it would be expected, is generally hard in texture and vitreous in appearance. There has developed lately an overseas demand for Cyprus hard wheat from a number of European countries for use in the manufacture of macaroni and other allied products, a fact that indicates that Cyprus durum wheat is considered of sufficiently good quality for this purpose. Locally it is used for bread-making in admixture with imported soft wheat.

Although wheat is sown in Cyprus in late autumn, the varieties grown should be classified as spring wheats.

Barley.—As with wheat, most of the barley varieties cultivated in Cyprus are very old forms of uncertain origin. They are six-row types belonging to the species *Hordeum hexastichon*.

As with all field crops cultivated in Cyprus under rain-fed conditions, the barleys are very early maturing and admirably suited to the local climatic environment. Barley matures earlier than wheat and for this reason it is a more reliable crop to grow under the erratic rainfall conditions usually experienced in this country.

The local barley varieties suffer from the disadvantage of being particularly susceptible to lodging. This defect is probably the result of long years of natural selection of types suited to the lighter and poorer soils. However, with the improvement of soil fertility through the use of fertilisers, this defect has become evident and has acquired economic significance.

Cultural practices

In common with other countries of low seasonal rainfall, the predominant system of cropping in Cyprus is the wheat– or barley–fallow rotation. The present system, which has been practised for centuries in the belief that the clean cultivated fallow accumulated all or most of the rainfall which fell on it in one year and made this additional supply available to the cereal crops, has been shown to have been based on wrong assumptions. Experiments conducted locally demonstrate that the effect of fallow on the increased yields of the subsequent grain crop is due solely to the increase in the amount of available nitrogen and phosphorus in the soil. Soil moisture has been shown to be the same under stubble and fallow during the late summer months.

The only crops that are sown, to any extent, on unirrigated land, in rotation with cereals are the legumes, broad beans (*Vicia faba*), Rovi (*V. ervilia*), Vicos (*V. sativa*), Louvana (*Lathyrus ochrus*), chick-peas (*Cicer arietinum*), lentils (*Ervum lens*), grown for their seed, and linseed (*Linum usitetissimum*), grown both for fibre and seed.

With the increasing pressure on the land the cereal–fallow rotation is not, however, a sufficiently intensive form of land use. Experiments conducted by the Department of Agriculture have indicated that in most cases it would be profitable to grow vetches (*Vicia sativa*), known locally as Vicos, in the place of fallow, particularly if the crop can be grazed *in situ* when still green. A significant increase in the cultivation of Vicos has been observed in recent years following the efforts of the Department of Agriculture to encourage farmers to grow this crop.

There are, however, considerable difficulties to overcome before the traditional system of rotation is changed. Under the conditions of uneconomic size of many farms and of the extreme fragmentation prevailing in Cyprus, a suitable rotation is not always easy to follow. The fact that most farmers do not own animals capable of making economic use of the legume crops is another serious obstacle.

Under the cereal–fallow rotation two cultivations are usually carried out during the fallow year in preparation

TABLE 1

Crop year	*Wheat*		
	Area sown, ha.	*Production, metric tons*	*Yield, metric tons/ha.*
1951–52	77,431	54,864	0.74
1952–53	74,247	67,381	0.80
1953–54	74,168	71,059	0.96
Crop year	*Barley*		
	Area sown, ha.	*Production, metric tons*	*Yield, metric tons/ha.*
1951–52	56,792	57,912	1.0
1952–53	57,267	66,995	1.1
1953–54	56,796	69,900	1.2

for the sowing of cereals. One in January, to kill the weeds that have germinated after the winter rains, and another soon after the first rains in autumn. These cultivations are carried out either by means of the traditional wooden nail plough or by tractor. At the present time there are 1,200 tractors available for agricultural purposes on the island. In 1954 the total cultivated area was 438,000 ha. Of this total, 75,700 ha., mostly intended for cereals, was cultivated by tractors.

Sowing is carried out chiefly by hand, broadcasting at the rate of about 150 kg. of seed of wheat and 170 kg. of barley per ha. Although these seed rates appear to be comparatively high, they have been found by farmers, through long years of experience, to be the most suitable to insure against the ravages of bird and insect attacks and drought at sowing time.

Until recently most of the cereal crops in Cyprus were cut by sickle and threshed in the traditional local method by the use of the threshing board. Postwar years, however, have witnessed a tremendous increase in the area harvested by mechanical means. At the present time about one-third of the area under both wheat and barley is harvested by combine harvesters. The necessary equipment is frequently owned by contractors, who usually undertake to harvest crops on a percentage basis.

Farmers have found combine harvesting very convenient, as it dispenses with the necessity of carting sheaves to the threshing floor, which is a very expensive operation involving considerable loss of grain. On the other hand, the small size of the plots creates operating difficulties, which naturally raises the cost per hectare. Fortunately, fences or other boundary obstructions are few, especially in the main cereal-growing areas.

Imported stationary threshers of the Western type have not met with favour in this country because they do not break the straw to the required degree of fineness liked by the local farmers for feeding livestock. Lately, however, it has been possible to design and produce locally a satisfactory peg drum type of threshing machine, which gives a bruised straw comparable with that obtained from the threshing floor.

About one-sixth of the land under cereals can be flood irrigated in winter or spring once, or twice if the season is favourable. During some seasons, however, almost no water at all is available for such purposes. Irrigation, where practised, is applied to wheat in preference to barley.

Cypriot farm labourers harvesting in the traditional way

Under local conditions cereal crops usually respond well to applications of fertilisers. It has been found that the most economic applications are in the region of 190 kg. of single superphosphate and 115 kg. of a nitrogenous fertiliser, such as sulphate of ammonia, per hectare. No responses to potassic fertilisers are obtained from cereals in Cyprus. Of course, not all farmers use fertilisers or use them in satisfactory amounts. Since the war, however, the quantities of fertilisers imported have increased very substantially. At the present time about 41,000 metric tons are imported annually, of which about 60% is estimated to be used in cereal production.

Weed control

Weed control is an important factor in the successful production of cereals in Cyprus. Many farmers still resort to control by hand-weeding, but under the present-day conditions of high labour costs it is doubtful whether this operation is economically justified. Weed control is being increasingly practised by means of chemical weed-killers. About 10% of the land under cereals is now sprayed or dusted for this purpose. Use is being made in some areas of aeroplanes for these operations.

There is little doubt that if the application of both phosphatic and nitrogenous fertilisers is practised at a suitable rate on all lands, and if weed control is carried out with greater efficiency, the total production of cereals in this country could be raised very appreciably.

Diseases and pests

One of the most important problems confronting cereal growers in Cyprus is the successful control of diseases and pests which cause great financial losses every year.

The most important group of diseases attacking wheat are the rusts. Stem rust, *Puccinia graminis tritici*, causes the most spectacular and perhaps the greatest losses, reducing yields appreciably in years of severe epidemic. The *Helminthosporiums* is another group of diseases which is responsible for considerable losses. The most important species are *Helminthosporium sativum* and *H.* (*Pyrenophora*) *repentis*.

With barley the most important disease is net blotch, caused by *H. teres*. Next in importance is *Erysiphe graminis hordei* and leaf rust, *Puccinia hordei*.

Of the insect pests, *Syringopais temperatella* Led., the cereal leaf miner, is the most serious pest of wheat and barley in Cyprus. It can be effectively

Many Cypriot agriculturists are now able to take advantage of the new machinery during the harvesting period

and economically controlled, however, by the application of DDT or BHC.

Improvement work developments

Systematic work on the improvement of wheat and barley did not start until recently. In the present programme, which is as yet in its early stages of development, emphasis is being laid on testing thoroughly varieties obtained from countries with a more or less similar climate to Cyprus. The introduced material is at first studied in detail, under nursery conditions, to assess its value for either breeding purposes or direct cultivation under field conditions. In these observations particular emphasis is given, with wheat, to stem-rust resistance and earliness in maturity combined with productivity. With barley, attention is mainly centred on such characteristics as resistance to net blotch and on the strength of straw. In parallel with these studies a survey of the prevailing races of the stem-rust disease is being made under greenhouse conditions. Up to the present, five races of *Puccinia graminis tritici* have been isolated, namely, 14, 17, 24, 53 and 117, of which race 14 is by far the most widely prevalent.

A number of breeding projects is also under way, aiming at incorporating stem-rust resistance to the local wheats and improving the straw strength and standing qualities of the local barleys.

Seed-production scheme

A seed-production scheme was also started recently by the Department of Agriculture to provide farmers with clean, pure cereal seed. The quantity of certified seed distributed to farmers was raised from 660 metric tons in 1953 to about 4,000 metric tons at the present time. This quantity is considered to be adequate. The yearly requirements in wheat and barley seed for the whole island amounts to 20,000 tons, but, of course, there should be no need for farmers to change their seed every year.

Storage facilities for cereal grain are also steadily improving. Underground storage pits of 10,000-tons capacity are at present under construction for storing barley grain to insure against bad crop years. Grain silos of the tower type are also projected for erection at ports for storing imported wheat.

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Development in Bulgarian Agriculture—II

(*Continued from page* 276)

stations in return for a certain remuneration. Poor and middle peasants have pooled their land in the co-operative farms. *Kulaks* are not admitted to them. Joining the co-operative farms is done in a completely voluntary way.

It is characteristic of the co-operative farms in Bulgaria that because private ownership over the land exists there is an absolute land rent, though in a modified form, unearned increment for the persons owning that land. However, the rent is not fixed by the individual farmer, but by the co-operative founded by people who have agreed to build a new type of farm.

Hired labour

The co-operative farms apply the principle of common labour contributed by the members of every farm, without any hired labour except that of agronomists, machine operators, book-keepers and accountants, and the necessary number of workers for the construction of farm buildings, whereby all conditions and opportunities for the exploitation of man by man have been done away with.

Incomes

Incomes in the co-operative farm are distributed among its members according to the work they have put in. No less than 75% of the co-operative farm net income is distributed among the co-operators according to the work-days contributed by them during the year. The rent on the land pooled in the co-operative is paid according to its size. It may not exceed 25% of the co-operative farm net income. The individual co-operative farm member is allowed to keep his own personal, auxiliary farm (a plot of land and productive cattle for his personal needs and those of his family).

Under this system of labour organisation in the co-operative farms, having realised the benefit of work in common and free from exploitation, the Bulgarian peasant co-operators now display remarkable creative initiative in increasing agricultural output by introducing new progressive methods of tilling the land and raising agricultural crops.

Seaweed for Fertility

T. LOFTUS-TOTTENHAM

(*Chase Protected Cultivation Limited*)

Seaweed has been used from time immemorial for fertilising many crops and there are, now, excellent scientific reasons for the beneficial effect it has on crops. In this article a method of treating seaweed to make it even more beneficial, has been described. It is a solubilisation process and the seaweed is converted into a water-soluble liquid.

SOMEWHAT more than a year ago several articles were published by W. H. Pawley, of FAO (WORLD CROPS, 1954, **6**, 481), discussing the possibilities of increasing world food supplies. Every step which was suggested contained such qualifications as ' given adequate transportation and use of fertilisers ' or ' fairly heavy use of fertilisers will be called for '. The interested layman will, however, be not unfamiliar with the other side of the picture. A considerable and increasing body of responsible opinion in many parts of the world is becoming alarmed at the serious effects of the continued use of fertilisers—and yet more fertilisers. Where does the truth lie?

Crop requirements

Assuming that temperature and rainfall (or adequate systems of irrigation) are suitable, what are the requirements for maximum crop production? They are, quite simply, the continued availability to the crop of the following: (1) nitrogen, (2) phosphorus, (3) potash, (4) essential trace elements.

The basic assumption made by FAO appears to be that the only way to ' give ' these four requirements is by deliberate external chemical means. I believe this assumption to be a most dangerous fallacy.

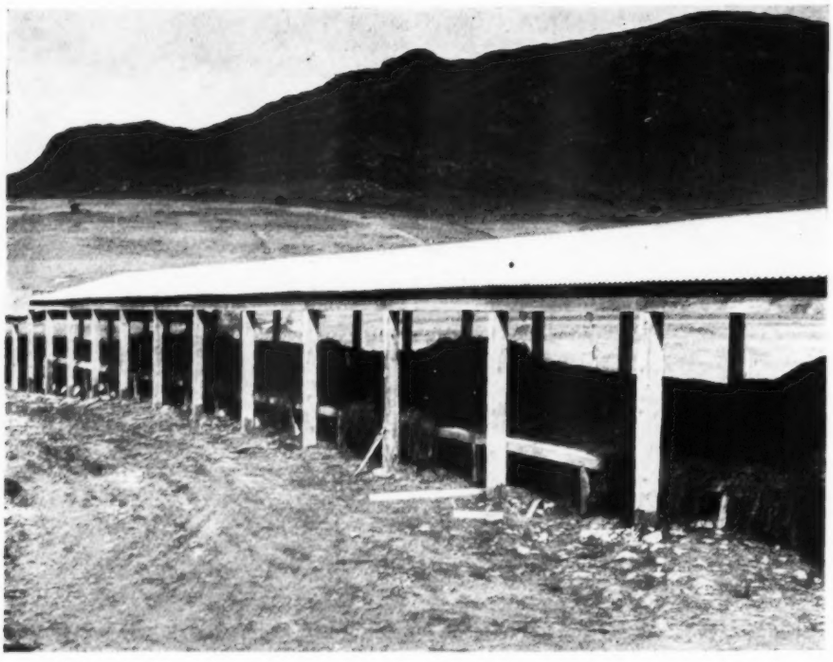
It will, I think, be not disputed that very few regions indeed are in fact deficient in either potash or phosphorus in the literal sense. If one ignores regions that are obviously unsuitable for cultivation on other grounds, the number is reduced still more. The trouble is, of course, that the mere presence of the elements is not sufficient; they must be present in a form available to plant life. In other words, they must be present as water-soluble salts. The fully-stocked larder is there. How can we unlock the door? If this is easily and economically possible, how preferable it is to do this rather than to bring fresh food from outside. Apart from any other consideration, the food provided by man—agricultural scientist or practical farmer—will only be an estimate of what the real needs of the crop are. There is no chance at all that the ' dosage ' will be exactly right. Can we, then, unlock the larder door? The purpose of this article is to show that we can.

Harvesting seaweed on the east coast of Scotland. Several different varieties (12) *are blended to obtain a balanced product*

Use of seaweed

From time immemorial the ancients used seaweed for their crops. Our scientific knowledge can now find excellent reasons why they found it to be so beneficial. Seaweed contains all the three essential elements, nitrogen, potassium and phosphorus. It also contains every one of the essential ' trace elements ', such as boron, iodine, manganese, magnesium, to name a few. Seaweed provided humus, and its content of alginic acid was a natural soil-conditioner. (Centuries elapsed before another acid of the same group became the basis of the present-day soil-conditioner.) Seaweed encourages the earthworm to breed and multiply and do their job of cultivating and aerating the soil. Why, then, do we not follow the example of our forebears and use seaweed ourselves?

Unfortunately, although all that has been said in its favour remains true, there is one disadvantage so great that it overshadows everything else. Apply untreated, raw seaweed to your soil and you will be unable to take a crop for months. Your soil will become



Preliminary drying of seaweed before liquefaction

starved of nitrogen! The reason is that in breaking down seaweed the soil bacteria need to live and their food is the soil's nitrogen. What, then, is the answer?

Solubilisation

One answer lies in a recent discovery by an English biochemist who has patented a process of ' solubilisation ' by which seaweed is converted into a water-soluble liquid. The original ' goodness ' of the seaweed is maintained in full, but the seaweed has already been broken down and no further action is needed by the putrefying bacteria, and thus no loss of nitrogen when it is applied to the soil. The liquid is, however, an excellent culture medium. It provides all the food needed by the millions of bacteria in the soil whose lifework is devoted solely towards assisting plant life.

As mentioned above, virtually no soils are actually deficient in potash or phosphorus; these elements are always present in insoluble forms. Certain species of bacteria exist whose life is entirely devoted to converting these insoluble salts into soluble counterparts. Thus, if sufficient healthy bacteria are present, there will never be a shortage of potash or phosphorus immediately available to the crops. What, then, of nitrogen? the third partner in the big three. Once more nature has arranged that there shall be yet other species of bacteria which make nitrogen available by ' fixing ' it from the atmosphere.

Strawberries after two early applications of liquefied seaweed

One more point remains: can we be sure that the crops will know how much of each element they should take? Fortunately for us the answer is an emphatic yes. Unlike human beings placed in similar circumstances, plants, both young and mature, seem to know exactly what they need and when they need it. Unlock the larder door and you may safely leave the rest to them.

To sum up, this then is the position. At the moment some of our leading experts are guessing at what a crop needs. The man on the spot varies the guess through his knowledge of local conditions and carefully watches the weather so that he can vary it further should the amount of sunlight be less or greater than the normal. The result is fed chemically to the plant, which is forced to take it whether it agrees with it or not. Trace elements are ignored until a deficiency in one or another is evidenced by disease, by which time it is too late.

Advantages

Contrast this with land treated with liquefied seaweed. There is one substance to be applied and one only—and the quantity does not vary from crop to crop nor at different stages of growth. There is no danger of overfeeding, either. Liquefied seaweed can never produce lush, sappy growth: the only disadvantage of using more than necessary is that of waste. Likewise, there is no more danger of spoiling the land and creating more dust bowls!

Finally, seaweed contains valuable plant hormones and these promote vigorous and healthy root formation. That is why crops fed on liquefied seaweed are always earlier, heavier and have a markedly increased resistance to disease. But that is another story!

To Authors and Readers

The publishers of WORLD CROPS invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance, addressed to the Book Production Manager.

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NEW PUBLICATIONS

Gall Midges of Economic Importance

By H. F. Barnes, M.A. (OXFORD), PH.D. (LONDON). Foreword by Prof. H. W. Miles, D.SC. (MANC.), Wye College, University of London. Vol. VII. Pp. 261, illustrated. London: Crosby Lockwood and Son Ltd. 1956. 21s.

The great economic importance of gall midges and their unusual biological characteristics, such as the slowing down of vital processes during unfavourable seasons, tend to arouse particularly great interest in a book on these insects.

When the book is the work of a taxonomist of international repute on gall midges, who has been conducting research on this group of insects for over 20 years, it becomes of even greater interest and value.

This volume is the seventh by Dr. Barnes on gall midges of economic crops, the first of the series being published nearly 10 years ago. Dealing as it does with the gall midges which attack and seriously damage the world's cereal crops, this volume may create wider interest than any of its predecessors.

Dr. Barnes gives detailed accounts of a wide range of species of gall midges from the oldest known cereal pest, the hessian fly, to the destructive sorghum midges, some of which have not yet been identified.

There are separate sections on the gall midges injurious to wheat, oats, barley and rye, to the sorghums, to the Panicum millets and to paddy or rice respectively. Each section is introduced by a discussion of the botanical characteristics of the host plants and a list of the gall midges attacking them. There follow detailed descriptions of the insects associated with (*a*) the inflorescence and (*b*) other parts of the plants in the sections dealing with wheat, oats, barley, rye, sorghums and Panicum millets and of the species causing a leaf-sheath gall of paddy.

Comprehensive references are given to previous work on the insects described and the taxonomy of the various midges is fully dealt with. Life histories and distribution of the various species are described, and the damage caused, and possible control measures, biological, chemical and cultural, are fully discussed. Brief descriptions of the less-important species are given and a number of unidentified species are discussed. The book is illustrated by a number of excellent plates, showing the different stages of some of the midges themselves and the damage done to the crop plants. There are also seven text illustrations in the form of graphs and other figures, a complete index and 526 references to literature.

The author not only presents the results of his researches on gall midges themselves, but discusses in great detail the relationship of these studies to crop husbandry, crop protection, crop improvement and plant breeding.

This is an invaluable reference book, therefore, not only for systematists and agricultural entomologists, but also for field officers concerned with many and varied branches of agriculture.

E. F. S. SHEPHERD

Lucerne Investigations, 1944-1953

Published by the Grassland Research Institute as Memoir No. 1. Lucerne is a plant which makes heavy demands on soil fertility. In this memoir data showing the reaction of lucerne to different types of management are presented; the evidence comes from critical experiments in the field conducted at the Grassland Research Institute and elsewhere.

It is thought that the memoir may be found useful as a record of the agronomic behaviour of lucerne, a plant which should be used much more widely throughout Britain. In the drier districts of England lucerne can be the basic legume and in other districts it should provide the basis for special-purpose drought-resisting leys.

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Vegetable Oils and Oil Seeds

A review of production, trade, utilisation and prices relating to groundnuts, cotton seed, linseed, soya beans, coconut and oil-palm products, olive oil and other oilseeds and oils. This booklet contains detailed statistical appendixes showing, for the main consuming countries, the supplies of vegetable oils, the annual production of soap, margarine and compound cooking fat, and the quantities of the various oils and fats used in these commodities. There is a section on import duties on oils and oilseeds in importing countries and an analysis of world production, trade and prices of whale oil. London: H.M.S.O. 5s. od.

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The Insect Pests of Vegetables in the Sudan

This is Bulletin No. 16, published by the Ministry of Agriculture, Sudan Government, and prepared by D. G. Pollard. This bulletin has been designed to give an account of the more important vegetable pests, including, where possible, details on life histories and habits as well as control measures. The accounts refer mainly to the northern and central Sudan, since it is within these regions that the majority of observations and experiments have been conducted. Price 40 P.T. 8s. od.

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British Insecticides, Fungicides and Weedkillers

A directory for 1956, prepared by the Association of the British Insecticide Manufacturers. This directory presents a directory of member firms, of products and services, and a list of proprietary and trade names and marks.

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University of Sydney School of Agriculture

Report No. 1, December 1955. The aim of this report has been to review the establishment and development of the Sydney University School of Agriculture and to provide a brief though comprehensive statement of the work of its several sections for the period 1951–54.

Besides indicating to those engaged in agricultural teaching and research, the scope of the school's interests, it is hoped that the report will prove of interest to the wider audience of primary producers and related organisations.

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FAO Publications

Food and Agricultural Legislation, 1955, 4, No. 3. This selection of publications deals with land tenure and land reform in Denmark, Spain and Sweden and land improvement in Spain.

Tree Planting Practices in Temperate Asia: Japan. This paper deals with seed, nursery and planting practices in Japan, which may have application in other parts of temperate Asia. It is, therefore, prepared under the direction of Masataka Ohmasa, Director, Government Forest Experiment Station, Meguro, Tokyo. It is published as FAO Development Paper No. 10. Price $1.50. 7s. 0d.

Tractors for Logging. This paper on the subject of logging tractors has been purposely restricted to hauling. In choosing a tractor for forest work, however, it is clearly often necessary to envisage its use for other tasks, such as the construction and maintenance of roads, the ploughing of forest ground, the mechanised tending of plantations etc. Within the limited framework of this study it has not been possible to cover all these problems and the reader is referred to specialised works on the use of tractors in civil engineering and agriculture. These subjects have been dealt with by many authors and are better known than the problems surrounding the use of tractors used specifically for forest work. It is published as FAO Forestry Development Paper No. 1. Price $2.00. 10s. 0d.

World Catalogue of Genetic Stocks—Wheat, Supplement No. 5, 1955. This issue of the 'World Catalogue of Genetic Stocks of Wheat' includes contributions from Belgium, Egypt, India, Union of South Africa and the U.S.A. The tabulations are in the same form as in previous issues and are as follows: Tabulation of Characters; Key to Genetic Stock Numbers; Alphabetical List of Varieties; List of Participating Countries and Stations Indicating Genetic Stocks Held by Each; Key to Country and Station Codes.

Les Plantations et Autres Domaines à Gestion Centralisée. One of the last documents presented by the late Sir Bernard O. Binns, K.B.E., dealing with various aspects of the utilisation of soils and waters. Price $0.50.

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Home-Grown Threshed Peas Joint Committee

Report for 1954. This describes the activities of the committee in that year and is comprised of three sections as follows: (1) Tenth Annual Report, (2) Report on Dried Pea Seed Approval Scheme and (3) Progress Report on Field Experiments.

Other Publications

We have received copies of the following:

Documentação Sobre O Arroz (Documentation on Rice), Preliminary World List of Institutions and Periodicals, 2nd Edition. Prepared by Comissão Reguladora do Comércio de Arroz, Rua da Madalena, 179, 2° Lisbon, Portugal.

Testing of Agricultural Seeds Moving in International Trade. Published by The European Productivity Agency of the Organisation for European Economic Co-operation, Paris. Proceedings of the Cambridge Conference, 18 June to 3 July, 1954. Price $1.25, 400 F. 8s. 0d.

Mauritius Sugar Industry Research Institute, Annual Report, 1955. The development of the Sugar Industry Research Institute during the second year of its existence has been summarised in the Chairman's report. Some progress was made towards the completion of the accepted structure of the Institute by the creation of a cane pathology section, which started to operate in March, and steps were taken to begin investigations in sugar technology early in 1956. The new chemistry, foliar-diagnosis and cane-analysis laboratories were opened in July and the sugar technology laboratories were completed.

The same pattern has been followed in the presentation of the 1955 report as in the previous year. The work of the Institute is briefly reviewed. The results of current investigations are reported separately by individual members of the staff. Important data on the sugar industry of the island are published in tabular form in an appendix. The descriptive account grouping essential information on sugar sectors of the island, which was published last year, has been slightly modified, but retained in order to facilitate reference.

Rabbit Clearance Operation

The special campaign organised by the Ministry of Agriculture, Fisheries and Food against rabbits in The Dukeries area of Sherwood Forest, Nottinghamshire, where an attenuated or weakened strain of myxomatosis from which rabbits recovered was found, concluded recently.

A force of 20 skilled men was recruited from all parts of the country for the operation and, reinforced by estate employees, local farmers, Forestry Commission workers and others, has been engaged since the beginning of February in systematically combing an area of over 20 sq. miles. The total force each day seldom fell below 60 and sometimes amounted to 100. In the course of the operations, which were hindered considerably during the opening weeks by wintry weather, about 500 rabbits were shot and some thousands were gassed in their burrows. Over two tons of cyanide gassing powder were used and it is believed that something like 95% of the rabbits in the area were accounted for. No rabbits affected by the weakened strain of myxomatosis have recently been seen. It will now be up to the occupiers to deal with the few remaining rabbits.

Attenuated virus

The first outbreaks of the disease in The Dukeries resulted in the usual high rate of mortality—about 99%—but subsequently rabbits were found to be surviving in considerable numbers. The attenuated virus was first isolated from wild rabbits in this area in April 1955.

In Australia many attempts have been made to replace the attenuated virus by a fully virulent strain, but without success. Rabbits infected with the standard strain of the disease are ill and infective for about a week, but with the attenuated strains they are ill for about three weeks. In consequence, where the more virulent and the attenuated strains run side by side, it is usual for the attenuated strain to persist and for the virulent strain to die out. The operation in The Dukeries was therefore mounted in an endeavour to prevent the attenuted strain from becoming established in this country at the present time.

MACHINERY AND EQUIPMENT

Self-propelled Windrower

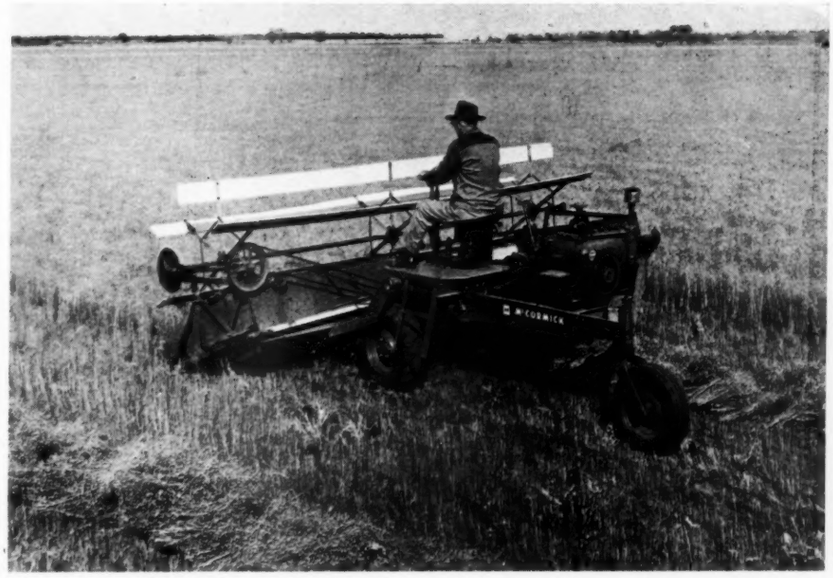
An all-new, self-propelled windrower, said to have the lowest-angled platform made, has been announced by International Harvester Export Co., 180 N. Michigan Avenue, Chicago 1, Illinois, U.S.A.

When set at its lowest cutting height, the centre-delivery platform of the new windrower has a maximum working angle of only 23°. The angle becomes even smaller as the platform is raised. This feature, it is explained, makes it possible to build crop-saving windrows in any grain, hay or seed that a farmer desires to windrow.

The low-angle, centre-delivery design of the platform interlaces stems of the crop being windrowed in what is described as a uniform, fluffy pattern. Thus the windrow is supported more readily by the stubble for the best drying and cleanest pick-up, the company stated.

Singled out as another big advantage of the new windrower is a convenient one-lever hydraulic control. With this the operator can raise and lower the reel alone, or the reel and platform at the same time. All the operating controls are located in an easy-to-reach position.

Two steering levers, directly in front of the operator, control the planetary gear drive for exceptional manoeuvrability. A foot pedal controls the variable-speed drive to change speeds. This permits the operator to select any one of the seven travel speeds by simply touching his toe to the pedal.



The self-propelled McCormick International windrower shown working in a flax field. Variable-speed drive provides ' on-the-go ' speed changes at touch of toe on foot pedal. Operator can raise and lower platform and reel, or reel alone, easily with one control lever

A sure-holding foot brake is also regular equipment. Safe highway transport is assured through a narrow wheel tread.

The new McCormick International windrower is available with a 12- or 16-ft. platform and a 25-h.p. air-cooled, or 30-h.p. water-cooled, heavy-duty engine.

Mid-mounted Mower

The Busatis mid-mounted mower (Busatis - Werke, G.m.b.H., Remscheid-Lennep, Germany; Watveare Overseas Ltd., Cantrell Works, Ivybridge, South Devon) is available for all makes of tractor. Quick attachment and detachment prevents loss of time between operations. The mower is provided with rapid-locking devices which allow one man to attach or detach the whole mower, without the use of tools, in a matter of minutes only. There is no reduction in ground clearance under the tractor and consequently it is always possible to use any other mid-mounted implement without any trouble. For raising or lowering the cutter bar either the tractor's own hydraulic power can be used or else a hand lift lever can be supplied for this purpose.

Other advantages include:

Tubular steel construction.

The drive operates through precision bearings and lubrication is by high-pressure grease nipples throughout.

Double V-belt drive from the p.t.-o.

Easy belt adjustment.

Well-protected drive.

The Hyster ZA-80 (8,000-lb. capacity) lift truck, equipped with load-grab lifting a boulder

Fork-lift Trucks

Two completely new fork-lift truck models have been released to industry, according to an announcement of the Hyster Co., Portland, Oregon; Peoria and Danville, Illinois; and Nijmegen, The Netherlands. They are an 8,000-

Many pieces of ancillary equipment are now available for use with the 'Farmers' Boy Major'

lb.-capacity truck and a 6,000-lb.-capacity model. Both are gasoline-engine-powered and mounted on pneumatic tyres. Both in design and mechanical features the trucks are refinements of the latest in lift-truck research and engineering.

Designed as an ideal 'outside' truck, the ZA-80 is the first heavy-duty 8,000-lb.-capacity industrial truck of its kind that can be operated efficiently indoors as well as out. Special attention was given to operator comfort, ease of daily servicing and safety. Other outstanding features are shorter overall length, longer wheelbase and better weight distribution than usually found in a truck of this size.

Among the many new mechanical features of both trucks are a long-life clutch that can be completely removed or installed in less than an hour and large, heavy-duty, disk-type industrial brakes that eliminate many service and maintenance problems. In addition, both use powerful industrial engines designed especially for the heavy work lift trucks are subjected to. Both trucks were thoroughly tested for two years in industry under actual field conditions before being released.

The two new trucks are now being shown by all authorised Hyster dealers in the U.S.A. and Canada as well as the remainder of the free world.

Tractor Cabin

Daniel Fernandez - Arroyo Abad, Caserio Imperial, 199, Apartado No. 8, Villanueva del Arzobispo (Jaén), Spain, offers for immediate delivery prefabricated metal tractor cabins. They are constructed for those makes of tractor that are in greatest use in Spain.

They are solidly constructed and are very easy to mount. The windows can quite easily be dispensed with. The cabins are supplied packed and painted in the original colours of the tractor.

The new unspillable Exide fence battery. It has a capacity of 20 A.h. at the 100-hour rate of discharge

Fence Battery

A new Exide fence battery, built to withstand the rigours of all-weather operation and hard usage, has just been introduced by Chloride Batteries Ltd., Clifton Junction, Swinton, Manchester, England. It is the 3-DU3, a new 6-volt unit.

The plates are of the well-known Mass type, a design which has proved its exceptional qualities for over 25 years. Separators made of 'Porvic', a microporous plastic material, provide a continuous diaphragm between the plates and obviate the possibility of internal short circuits. A special electrolyte absorber known as 'Diatomite' fills the entire acid space and makes the battery completely unspillable.

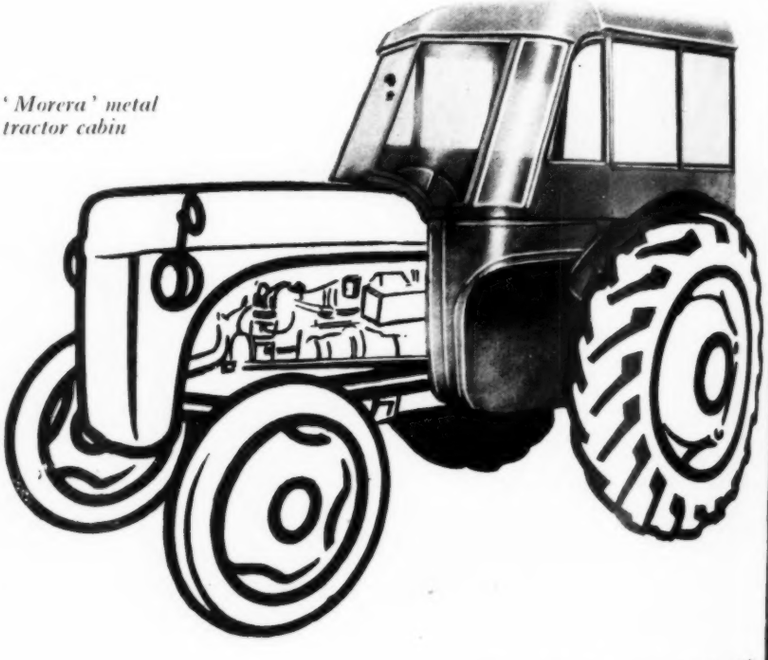
Other special features of this unit are the tough one-piece moulded container, large filling orifices to simplify routine maintenance, colour coded terminals which are not interchangeable and fully-shrouded intercell connections to prevent accidental short-circuits.

With a capacity of 20 A.h. at the 100-hour rate of discharge, the Exide 3-DU3 weighs 15 lb. fully charged and measures $9\frac{5}{16}$ in. long × $3\frac{5}{8}$ in. wide × $6\frac{1}{8}$ in. high. It is designed to provide the small current required by electric fences for long periods without recharges.

Combined Clutch and p.t.o

As recently announced by the Nuffield Organisation, their 'Universal' tractor is now available with a Borg and Beck dual-purpose clutch (Automotive Products Co. Ltd., Leamington Spa, Warwicks, England). This is, in effect, two separate clutches mounted in tandem; the inner clutch (which is nearer to the flywheel) being used to transmit the main drive to the rear

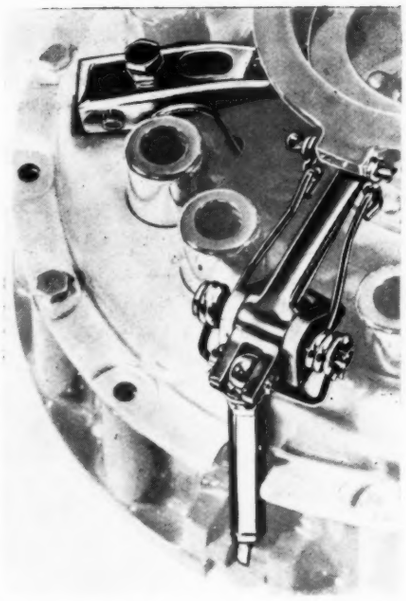
'Morera' metal tractor cabin



wheels, whilst the outer clutch provides a p.t.-o. Thus there is a transmission clutch and p.t.-o. combined in a compact integral unit and positioned ideally to transmit direct, more positive power for such implements as combine, baler or mower etc. In most cases the need for implements driven by separate engines is eliminated and with that the additional fuel and maintenance costs for engines, which depreciate in value during the many months when they are not in use.

The double clutch is built as one unit and bolted to the flywheel in the normal way. Each clutch incorporates a pressure plate, which, in the torque-transmitting condition, is clamped (by means of springs) against a rigid crimped-type driven plate fitted with normal friction facings. The drive from the engine is disconnected from the main transmission or the p.t.-o. by releasing the appropriate pressure plate from its driven plate in the usual manner.

The clutches are actuated by independent throw-out forks in conjunction with ball thrust bearings. The tractor transmission clutch is operated externally by an orthodox clutch pedal and the p.t.-o. clutch by a hand-control lever situated on the near-side, convenient to the operator's left hand. Power from the tractor main drive clutch is transmitted by a solid splined shaft to the primary shaft of the gearbox; the drive from the p.t.-o. clutch is by hollow splined shaft to flanged dog couplings, thence to a hollow spur pinion driving a gear secured to an intermediate p.t.-o. shaft.



A close-up of the combined clutch and p.t.-o. (Borg and Beck), showing the release-lever mechanism which operates the main drive clutch (lower) *and p.t.-o.* (above)

Grain Drier

The ' Lincoln ' Mark 1 grain drier (Penney and Porter Ltd., Riverside Works, Lincoln, Lincs) retains the labour-saving features of the larger models. It is of compact dimensions and utilises only a small amount of valuable barn floor space. If desired, an elevator can be supplied to feed the drier from a wet grain receiving pit. The oil-fired plant has a fine adjustment and control of the drying temperature up to a maximum of 180° F. Oil consumption is low (average 1½ gal. per hour) and running costs are economical.

Specifications

Complete with 5-h.p. motor and starter for hot and cold air fans and equaliser.

Motor (1 h.p.) and starter for bagging-off elevator, single- or three-phase supply, or can be supplied with countershaft for drive by stationary engine.

' Urquhart ' oil-firing equipment with full thermostatic control from 90° to 180° F.

Overall dimensions: 10 ft. 6 in. long, 7 ft. 6 in. wide, 11 ft. 3 in. high.

Rated throughput

The capacity of continuous driers is calculated on the basis of a moisture extraction of 5%, from 21% down to 16%, when drying wheat, utilising a hot-air temperature of 140° F., an atmospheric temperature of 65° F. and a relative humidity of 75%.

Mark 1 ' Major ':

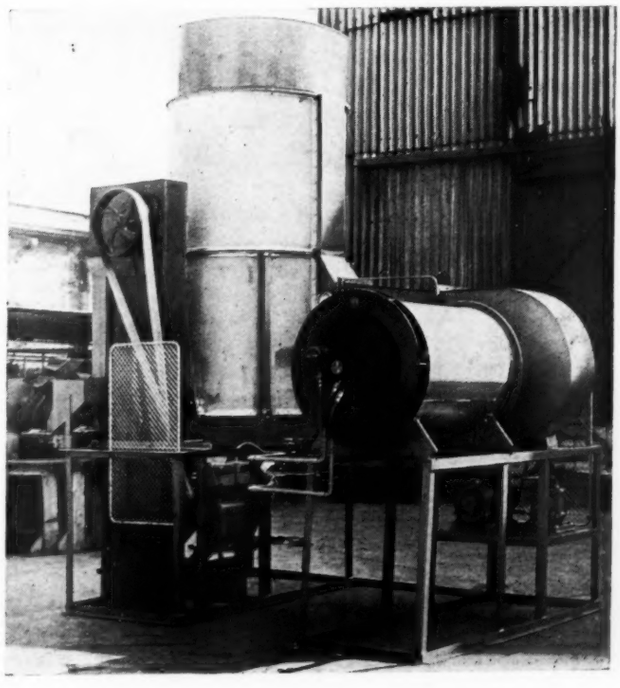
10 cwt. at 5% extraction.
20 cwt. at 3% extraction.

Farmers' Boy Major

The ' Farmers' Boy Major ' has now been in production for over six months; it is a simple robust machine which is easily adapted to a number of uses, although primarily designed for ploughing, rotary cultivation and grass cutting.

The machines are already operating in Australia, New Zealand, Malaya, Thailand, East Africa, Mexico and British West Indies, as well as in the majority of European countries.

The ' Farmers' Boy Major ' is powered by a Villiers Mark 25, 3½-h.p., four-stroke engine, and alternatively for light work by a Villiers Mark 15, 2-h.p., four-stroke engine. Axle sizes are available from 18 in. to 36 in. and wheel sizes from 18-in. dia. to 30-in. dia. Front and rear mounting is avail-



The 'Lincoln' Mark I Grain Drier. With machinery of this type there is little fear of grain deteriorating in bin or silo. There are no sacks to turn and thus less labour is required for other vital tasks at harvest time

able for most implements. The ploughing assembly will operate to a depth of 8–9 in. with furrow widths up to 12 in. The 17-in. rotary hoe has positive depth adjustment from 1–9 in. For grass cutting and rough cutting there are available a 3-ft. 3-in. cutter bar, a twin circular scythe, cutting width 30 in., or a single circular scythe, cutting width 20 in.

The variety of wheel and axle sizes available to meet different soil and operating conditions in this country and abroad has proved to be one of the most popular features of the ' Farmers' Boy '.

In addition to the primary operations for which the machine was designed, the manufacturers, the Raven Engineering Co. Ltd., St. John's Road, Hampton Wick, Kingston - upon - Thames, Surrey, England, now offer a large cultivating frame, saw bench, 1-ton trailer, hydraulic hedge trimmer, a general-purpose pump and a range of spraying equipment.

Killer Kane

' Killer Kane ' is a slender, light, transparent, plastic cylinder, coloured green, the height of a walking stick. There is a fitting cap at the top and an exposed brass ferrule at the bottom, attached to a strong brass spring within the cylinder. This acts as a piston which, when pressed from the top, uncovers four jets and releases a measured quantity of the weedkiller with which the cylinder is fitted. It is designed particularly for lawns, grass borders etc.

The cylinder is filled with water in which one ' Killer Kane Kartridge ' has been dissolved. (This is 2,4-D weedkiller in tablet form, but other liquid weedkillers can be used.) Pinpoint the weed to die with the brass ferrule. Press the top lightly and the plantain or dandelion or nettle—or any of the 65 other varieties of despoiling weeds—will be drenched with a measured dose. Distributed by Mayborn Products Ltd., Dylon Works, Berryman's Lane, Sydenham, London, S.E.26.

Earth Auger

Mall Tool Co., 7,740 South Chicago Avenue, Chicago 19, Illinois, U.S.A., now manufacture the Mall 2MG earth auger. This implement is self-contained and no air compressors, generators or power lines are required. Two men can carry it to the site and drill 6- to 12-in.-dia. holes up to 5 ft. deep in a short space of time. The special transmission delivers a full 95% of the engine's $5\frac{1}{2}$ h.p. to the auger.

A domestic-type weedkilling implement. The ' Killer Kane ' to treat weeds in lawns, crazy pavements, rockeries etc.

Specification

Engine: $5\frac{1}{2}$-h.p., two-cycle, single-cylinder, air-cooled gasoline. All-weather ignition. All-position float-type carburettor. Automatic clutch. One-hand automatic rewind starter. Safety ignition switch. Finger-tip throttle control. Chrome-plated fittings. Die-cast aluminium–magnesium construction.

Augers: Replaceable cutting blade of hardened steel. Pilot auger is stellite tipped.

Auger extensions: Available in lengths for 5-ft.-deep holes.

Transmission: One-piece housing. Gears have 95% power-transmitting efficiency. Gears turn in liquid grease. Shafts operate on long-wearing ball and needle bearings.

Villiers Booklets

Operation and maintenance instructions and spare parts booklets for the Villiers Mark 15, Mark 20 and Mark 25 four-stroke engines and Mark 25C two-stroke unit have been revised to bring them up to date with the latest modifications and design trends and are available, on application, from the Villiers Engineering Co. Ltd., Marston Road, Wolverhampton, price 2s. each.

Marks 20 and 25

The Mark 20 and Mark 25 four-stroke engines are covered in one booklet, which now includes details of the oil-bath air-cleaner assembly and the slow-running control.

The Mall 2MG earth auger. This implement is easily managed by two men

WORLD CROP REPORTS

SOUTH AFRICA

Maize estimate

Rain was followed by sunshine in the period after data for this year's first South African maize estimate had been gathered. The second estimate shows an increase of nearly 1.5 million bags.

According to the Department of Economics and Markets, the latest estimate is 319,859,000 200-lb. bags, against last month's estimate of roughly 30.5 millions and last year's actual production of 36.4 millions.

ARGENTINA

Maize.—The first official estimate places the Argentine 1955–56 maize crop at 3.8 million tons or 49.3% above the 1954–55 crop. The last published 1954–55 crop estimate was 2,546,000 tons.

Sunflower.—The first official estimate of the area sown to sunflower is 1,220,000 ha., which is more than double last season's figure, but still below figures for the years 1942–52.

Rice.—The area sown to rice at 60,500 ha. is the smallest for several years.

Tobacco.—Tobacco plantations at 31,000 ha. are 9.8% less than last year.

Revised estimates

The Ministry of Agriculture has lowered its crop estimates for linseed (to 231,000 tons), oats (to 271,000 tons), barley (to 960,400 tons) and rye (to 172,200 tons).

VENEZUELA

Coffee. — The Venezuelan Coffee Growers Association estimated in February that this year's crop would be only 300,000 sacks—even smaller than was previously anticipated. Some compensation is afforded by present high world prices. The Ministry of Agriculture has plans on foot for improving cultivation methods and increasing both area and output.

LEBANON

Wheat.—Wheat production in 1955 amounted to some 50,000 tons from 70,000 ha., sufficient to supply approximately a quarter of the country's requirements. (Normally Lebanon produces a third of the wheat she needs.) Imports of wheat and flour rose from 147,000 tons in 1954 to 194,000 tons in 1955.

Citrus.—The citrus fruit crop of 1955 is estimated at approximately 100,000 tons, of which 43,000 tons were exported—21,000 tons to Syria, 10,500 tons to Czechoslovakia and 6,000 tons to U.S.S.R.

Apples.—Revised estimates for the apple crop of 1955 put the production at 22,000 tons, of which some 12,000 tons were exported entirely to other Arab countries.

Olives.—The olive crop suffered severely in 1955 and was less than 10,000 tons instead of the normal 45,000 tons.

Tobacco.—Tobacco production in 1955 was in the region of 2.4 million kg., of which a quarter was exported, mainly to France, America and Egypt. The U.S.S.R. is reported to have displayed an interest in purchasing Lebanese tobacco.

NICARAGUA

Coffee.—Production increased from 371,000 quintals in 1954 to an estimated 480,000 quintals in 1955.

Cotton.—Exports in 1955 are estimated to have realised U.S. $33\frac{1}{2}$ million, compared with about U.S. $18 million in 1954. The 1954–55 crop produced 203,493 bales of 500 lb. each. It was hoped that the 1955–56 crop would yield between 250,000 and 275,000 bales, but it is now expected that 225,000 bales will be nearer the mark. Cotton acreage in Nicaragua increased from 190,000 in 1954 to 360,000 acres in 1955, with a consequent reduction in the amount of land devoted to food crops.

General.—A combination of drought and reductions in planting late last year gave rise to a shortage of three main food items, maize, beans and rice. To help alleviate this shortage the Government permitted the duty-free import of up to 30,000 quintals of these items for the two months of August and September 1955. Shortages continued, however, and a later decree extended the period to 2 November and increased the quantity by 15,000 quintals.

The total value of agricultural, forestry and livestock production during 1955 is estimated at U.S. $132 million, of which U.S. $67 million was for local consumption.

The Institute of National Development and the Servicio Tecnico Agricola de Nicaragua (S.T.A.N.) are planning the systematic production of cocoa and ipecacuanha.

ENGLAND AND WALES

Agricultural report. Agricultural conditions in England and Wales on 1 May, 1956, have been summarised by the Ministry of Agriculture, Fisheries and Food.

Good progress was made with cultivations and sowing and work is more forward than usual. The growth of corn crops was retarded by cold weather. Pastures made very little growth. Cattle and sheep have done moderately well. Lambing in lowland flocks has been good and is proceeding satisfactorily in hill flocks.

Weather conditions.—The weather during April was generally cold, especially in the eastern half of the country. There were widespread ground frosts and keen air frosts in some places; snow fell in some northern areas during the last week of the month. Except in parts of the midlands and some south-eastern areas, sunshine was above average, while rainfall was below average almost everywhere.

Spring sowing.—The sowing of corn has been carried out under very favourable conditions during the month and in many areas has been completed. Land has worked well and good seed beds were obtained.

Corn crops

Autumn-sown wheat looks well generally, but growth has been slow. Damage by wheat bulb fly is reported from several areas. *Spring-sown wheat* germinated well, but has been slow to make growth.

Autumn-sown barley suffered severe damage by frost in February—particularly spring varieties sown in the autumn—and many crops have been resown with spring barley. True winter varieties are healthy, but generally not as forward as usual. *Spring-sown barley* has germinated well, but growth has been slow; loss of colour is reported from a few districts.

Autumn-sown oats were damaged by frost in February and some patching and resowing has been necessary, but in most areas crops are recovering, although growth is slow. *Spring-sown oats* have germinated well, but cold weather has retarded growth.

Mixed corn and *rye* are generally satisfactory but backward.

Roots

The preparation of land for root crops proceeded under very satisfactory conditions and work is more forward than usual. Land worked well and good progress was made with the drilling of sugar-beet, mangolds and fodder beet. Some early sowings of sugar-beet are showing in the rows.

Pastures

Leys have been slow to make growth, owing to cold winds and night frosts.

Permanent pastures made very little growth and provided less keep than usual.

U.S.A.

Small grains

Prospects have been generally improved recently by the precipitation which was moderate to locally heavy in the western half of the country except in the south-western area, and mostly heavy to locally moderate over the eastern half as far west as the Eastern Panhandle of Texas. Additional moisture was very badly needed in the area from the Mississippi River westwards over the Great Plains, according to the U.S. Department of Commerce Weather Bureau report to the week ended 4 May.

Wheat and oats.—Warm weather in the southern areas has stimulated development. Wheat and oats were in head in the South Atlantic and Gulf States, with wheat heading as far north as Southern Virginia and Southern Kansas. Rains were very timely in helping to fill heads in Northern Texas and in Oklahoma. In Kansas rains improved wheat prospects in the central and eastern portions, with cool, damp weather limiting the deteriorating effects of soil moisture deficiency in the western sections. Wheat was improving in Nebraska, where it is jointing in the southern portion.

Substantial precipitation during the last two weeks from the eastern portion of the Great Plains to the Atlantic coast was very beneficial in relieving droughty conditions. Too much rain caused further delay in soil preparation from Tenessee, the North Carolina area to Eastern Canada.

Maize.—This work was more advanced than usual in the western portion of the main corn belt, where ploughing has been about 90% completed in Iowa and Illinois. Early corn was being cultivated in the South Atlantic and Gulf States. About 35% of the corn has been planted in Virginia, a few fields in Kentucky and about 25% in south-eastern Missouri. In the main belt soil was still generally too cold for seeding.

EUROPE

Grain-crop damage

Western Europe's bitter winter caused serious damage to winter grain crops, largely owing to ' insufficient snow cover ', according to the U.S. Department of Agriculture. This was the Department's first appraisal of the February freeze-up, made for the benefit of U.S. farmers.

France suffered severely and may have ' little or no wheat to export during the 1956–57 marketing season ', the report said.

Three cold waves in February destroyed over 50% of France's 1956 winter wheat crop, in sharp contrast with the past three years, when France rose to fifth place among the world's wheat exporters after the U.S.A., Canada, Argentina and Australia.

The report said that an estimate based on average yields from the 5,400,000 acres of winter wheat in France that were not destroyed, and from an estimated 2½ million acres of spring wheat, indicated that the 1956 crop would range between 6 and 7 million metric tons (220 and 256 million bushels). Last year the French wheat crop amounted to 390 million bushels from 11,300,000 acres.

When the cold weather moderated about 2½ million acres was seeded to spring wheat and another 3,200,000 acres to other crops, mostly barley, so that France is expected to have a large barley surplus. Increased maize plantings may make the country nearly self-sufficient in that grain. Drought damage is now worrying France.

The percentage of damage was also high in *Belgium*. The winter wheat loss was officially placed at 47% of total acreage planted up to 1 January. Other grains also suffered.

The Netherlands lost an estimated third of the winter wheat planted. Unofficial estimates for *Western Germany* indicate overall damage to winter wheat of about 15% and in winter rye 10%.

Damage was not serious in *Italy*. Winter grain is in good condition in *Greece* and no significant damage was done to grain crops in *Spain*.

Frost damage to winter grains in *Switzerland* now appears more serious than was earlier expected, the report said, totalling about 40% for wheat, meslin and winter barley.

Much land is under water in *Yugoslavia's* important commercial grain area in Voidodina, and evaluation of damage to grain crops is not yet possible.

Autumn and spring sowings in *Turkey* are a month late in growth.

There was extensive damage to winter grain in the Ukraine, where most of the *Soviet Union's* winter wheat is grown, the report said.

INTERNATIONAL

Dried fig production

The U.S. Agriculture Department has estimated commercial dried fig production in 1955 in seven producing countries abroad at 148,700 short tons, 15% below the 1954 output in those countries of 174,400 short tons.

The report covered output in Algeria, Argentina, Greece, Italy, Portugal, Syria-Lebanon and Turkey.

' Early season conditions have been reported as favourable for the 1956 crop in Greece and Turkey ', the Department said.

The Department gave the following breakdown of commercial production as follows, in short tons:

Country	1954	1955 (*preliminary*)
Algeria . .	37,100	*
Argentina . .	1,400	1,700
Greece . .	30,000	28,000
Italy . .	57,900	43,100
Portugal† . .	11,100	9,800
Syria-Lebanon	3,900	3,100
Turkey . .	33,000	31,000
Foreign Total . .	174,400	148,700*
U.S.A.	25,600	25,300
Grand Total . .	200,000	174,000

* 1950–54 average for Algeria included in ' total '.

† Merchantable figures only.